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Qatari Money Reader: A smart mobile app to support persons with visual impairment – Supported by Mada Innovation Program

Thinkerbell Annie: World's First Self-Learning Braille Literacy Device – Winner of Mada Seedstars Award 2021

Unified Arabic Braille Portal by Mada: Innovative digital resource to reduce braille literacy in the Arab region

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Qatari Money Reader: A smart mobile app to support persons with visual impairment and the Elderly – Supported by Mada Innovation Program

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Abstract –

In 2018, Innovation Factory Limited developed a unique smartphone application called “Qatari Money Reader” fully funded through the direct grant stream under the Mada Innovation Program (MIP, 2021). The app can scan and identify Qatari currency by just using the camera of the smartphone. The solution was effective for people with visual impairment & the elderly while retaining their privacy by identifying the value of the notes when they are in public places or when they need to count their money. In Addition to that, the app includes other features like reading the Qatari Riyal currency in real-time and works entirely offline without the need to have internet connectivity. Once the currency is detected, the app will inform the user about the value of money in Arabic and English. With the update in the Qatari Bills, the Mada Innovation program supported the development of Money Reader App V2 with added features like new bill detection, Counting notes, Exchange notes and Experiment on fake note detection. Mada hosted focus groups and user testing sessions to evaluate the application before the official dissemination.

Introduction

Primarily, identifying the value of banknotes is one of the main challenges faced by people with visual impairments and elderly (Tian et al., 2019). Such challenges make it hard to exercise basic daily activities, like needing to seek assistance to determine the value and authenticity of such bills. There is a necessity for developing solutions that can evaluate the authenticity and value of local and major international currency bills using a mainstream device such as a smartphone. The increased hardware capability and portability of such devices make them ideal to serve as suitable platforms to integrate app-based solutions to resolving such challenges (MIP, 2019).

Traditionally, assistive technologies for the blind and visually impaired and elderly community tend to be in the form of expensive dedicated devices (e.g., braille readers, document magnifiers, computer screen readers, etc.) (El Ghouli et al., 2020). Mada Innovation program MIP (Al-Thani et al., 2019) intends to offer support to such solutions to solve daily life problems by incorporating the assistive technology solution into a mainstream device. This makes the solution available to a much wider range of users with Arabic and English language options having a significant impact within the blind, visually impaired and elderly community.

About the “Qatari Money Reader” application

With time, the “Qatari Money Reader” application received various feedback from users to add more features that it’s important for their daily life. For instance, when they travel abroad which will allow them to live independently without asking for help from the public or get scammed with fake notes or the incorrect amount by strangers. Also, the change in Qatari bills in early 2021 has made it mandatory for the app to be updated and modified with improved features.

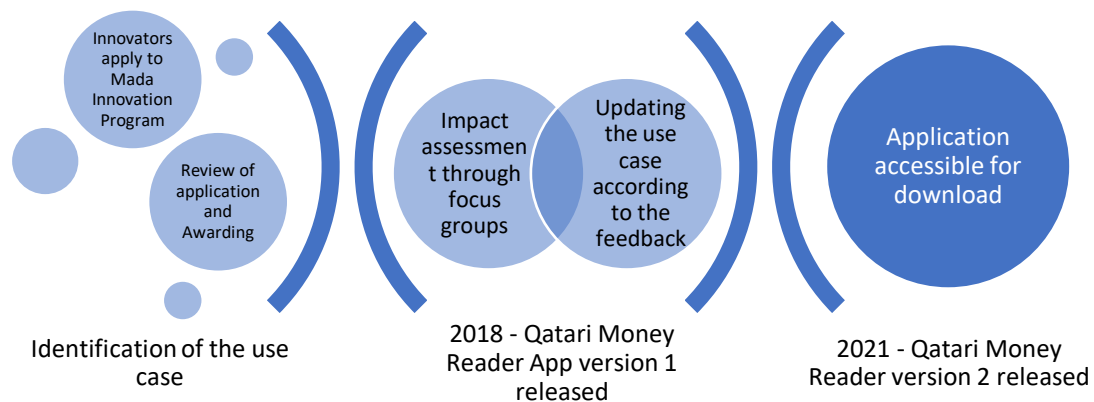


Figure 1. Innovation journey of Qatari Money Reader app (Mada Innovation Program, 2019)

Furthermore, MIP supported and funded the development of the upgraded version of money reader application has the first of its kind algorithm to calculate multiple currencies, exchange rates and can identify fake notes through the smartphone camera and through using the deep learning approaches using an UV light attached to the smartphone. Also, the program supported the money reader app in several steps of the project including the development, testing, and dissemination of the product through focus groups, user testing and show & tell sessions (MIP, 2021).

How does it work?

TensorFlow Library (Abadi et al., 2016) was used for image classification and high-performance numerical computation. It supports many classification and regression algorithms, and more generally, deep learning and neural networks. The system works by using a set of sample images of Qatari bills which are used to train a set of classification algorithms. The system is not trained by hand and does not rely on any hand-picked distinguishing characteristics usually found on such bills. Instead, a more robust machine learning approach is followed whereby the training data is used to guide the algorithm in recognizing similar bills when they are later presented to it by the visually impaired user. The current system design focuses on QAR, GBP, and US currency bills but the technique can be easily extended for other currencies.

A subset of image classification with object detection, where specific instances of objects are identified as belonging to a certain class of scanned bill was applied. In this specific case of image recognition, the features are the groups of pixels, like edges and points, of an object

that the network will analyze for patterns. The approach is scanning a wide range of parameters on each note:

- The shape of the notes
- Numbers & Texts
- Images & Colors
- Visible and hidden Patterns

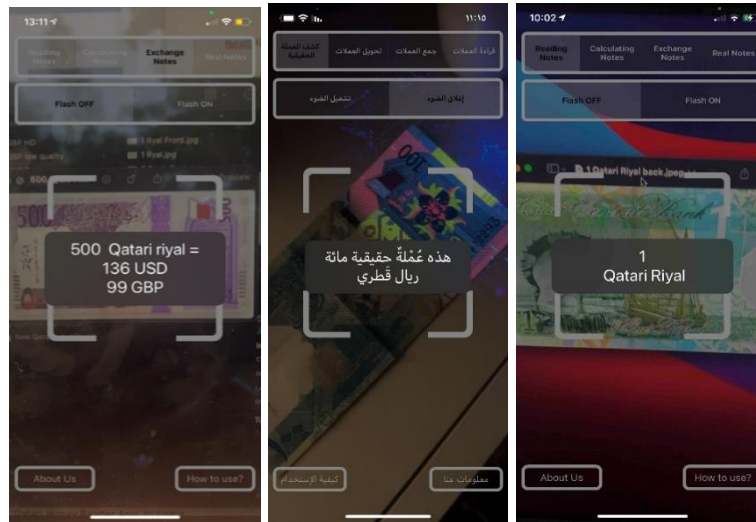


Figure 2. Screen Snaps of the Application Features (MIP, 2021)

The money reader app v2 had an experiment feature to detect genuine notes using UV lights. This feature was embedded to evaluate the effect on the bills and implement it permanently. For the genuine note's detection, the app requires an external UV light which will allow hidden patterns to be visible on the notes. Furthermore, the app is using an image processing approach to scan notes and detect them when hidden patterns are matched with the database. The updated features in the Qatari Money Reader app are:

- Support new currencies (USD, GBP, and new Qatari Riyal) detection
- Exchange to/from Qatari to/from (USD, GBP)
- Exchange Mix to/from Qatari to/from (USD, GBP)
- Counting (USD, GBP) currencies.
- Counting (USD, GBP) + Exchange to Qatari Riyal.
- Experiments on detecting fake and genuine notes using UV lights and other methods.

User testing and focus group validation process

User testing and focus group sessions were organized with eight attendees including people with visual impairments to discuss their needs and to provide feedback on the new version of the app. During the sessions, Easy to use feature, no buttons are required to use this feature only scan the targeted notes and will tell the exchange rates for other notes was appreciated by the users. IOS and Android Mobile phones loaded with Money reader Application was provided with a mix bag of New and old Qatari bill was provided to all attendees to test the application.

During the focus group session, the user highlighted how such an app will improve the independency and secured retail experience for the person with visual impairment or blindness. The solution ensures that persons with blindness can transact their monetary requirements independently and secure manner during their retail experience.



Figure 3. Focus-group for testing of Qatari Money reader app by persons with visual impairment to check the accuracy of recognizing genuine and fake bills using UV light

Based on the focus group and user feedback, the application includes scanning of the US dollars (USD) and British pounds (GBP) as those are the most commonly travelled destination, the app in total will support those currencies which will allow the user to feel independent. The app does not require internet access to get the exchange rate values as it has stored the last values from the market and when the connection is back the app will update all exchange values. Additionally, the counting notes feature allows users to count all 3 notes: QAR, USD, and GBP. At the same time, fake note detection using external UV light, the app was able to recognize all hidden patterns via the smartphone camera and notify the end-users when genuine notes have been detected.

How to download the App

The Qatari Money Reader application is available on both App Store and Google Play stores and attracts users to download and use it. To download the app, users can search the application stores on both platforms using the term 'Qatari Money Reader'. You can scan the QR Code to know more about the application and how to download.



Figure 1: QR Code to download the Qatari Money Reader App

Conclusion

Thus, the new version of the Qatari Money Reader app is one of the successes achieved by the Mada Innovation Program, which was designed to encourage innovators to find solutions

in Arabic for people with disabilities and the elderly. Lastly, the adoption of such solutions would also aid in eliminating the circulation of fraudulent currency notes by allowing users to instantly validate the authenticity of their notes.

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Toward Accessible Online Learning for Visually Impaired and Blind Students

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Abstract –

The widespread adoption of blended and hybrid learning models, and the increased use of learning technologies, especially in recent years, have caused several challenges for students with disabilities as they are facing more complex barriers accessing and using digital educational tools and materials. Although such concerns are relatively not new in online education, their impacts on equity, inclusion, and access for people with disabilities have been deepened considerably during the covid-19 pandemic. This paper discusses challenges in online learning for blind and visually impaired students and highlights innovative inclusive technologies to empower them accessing online education.

Introduction

According to the World Health Organization WHO, there are globally at least 2.2 billion people with vision impairment (WHO, 2019). Basically, there are two broad categories of visual impairment, with distinct characteristics and needs: individuals with low vision and individuals with blindness. Vision impairments can affect a student's independence, mobility, and educational achievements, depending generally on the type, extent, and timing of vision loss. Similarly, the impact of vision impairment on learning varies depending on the nature and extent of vision loss. Students with vision impairment face challenges while reading and writing, and accessing technologies, sometimes even when using optical aids. In classic face to face models, inclusive classrooms are supposed to provide all students with adequate adjustments and reasonable accommodations, and assistive devices and technologies (e.g., screen-magnification, screen-reading software, Braille displays and notetakers, etc.) fitted to their needs to facilitate as much as possible their access to learning. Nevertheless, it's not likewise in case of online learning models, especially in times of emergency and crisis where educators and students are not prepared to deal with such extra challenges.

It was indeed the situation during the current Covid-19 pandemic that has created unforeseen challenges for educators and students (McKenzie, 2021). Most educational institutions worldwide have rushed to online learning models since the spring of 2020, and the focus on online education and technology seems to persist as a permanent trend in education in the future. In fact, according to the Horizon report 2021, several key technologies are expected to have more significant impacts on teaching and learning practices, namely, Artificial Intelligence, Blended and Hybrid course models, Learning Analytics, Microcredentialing, Open Educational Resources, and Quality online learning (Pelletier et al., 2021). On that premise, the ecosystem of ICTs in education needs to be strengthened toward embracing alternative and innovative inclusive models for educating

students with disabilities harnessing the technology trends.

Online learning challenges for visually impaired and blind students

Whilst online learning has created unprecedented access opportunities to education, especially in periods of crisis and pandemics, it is unfortunately considered as an additional burden impeding students with disabilities, visually impaired and blinds, getting access to quality online education on equal footing with their peers. Undoubtedly, the major challenge remains in the availability of accessible instructional online materials and services, and innovative assistive technology solutions. Indeed, this is what has been noticeably reported by the community since the rapid shift in many educational institutions to online learning, and the widespread adoption of blended and hybrid learning models. Most of visually impaired students have complained about unresolved accessibility issues hindering access to online learning, like incompatible materials with screen readers, late publishing of accessible course materials, using learning management systems, accessing textbooks, unavailability of affordable assistive devices including Braille and embossed diagrams, studying STEM subjects online and dealing particularly with graphs and equations, taking synchronous lectures on video conferencing platforms, taking tests and exams on online testing platforms, etc. (McKenzie, 2021). So, what are the possible avenues to address such shortcomings toward providing accessible online learning for students with visual impairments taking advantage of the key technology trends.

Accessible digital learning content

One of the main pillars in the online learning model is to provide quality digital learning content. Therefore, there is a need to make existing learning content accessible and to produce new content aligned with digital accessibility standards and guidelines. To this end, educators shall be aware of key approaches to create and remediate/convert easily and rapidly their education resources into accessible documents. Many apps and platforms offer accessibility checking tools that identify accessibility problems and provide suggestions to help making content accessible. Apart from known key accessibility features for people with low vision (like brightness and color, fonts, spacing for reading, elements' identification, complexity of the content, etc.), the most prominent consideration remains in the compatibility of the content with screen readers (e.g., JAWS, NVDA, Voice Over, Narrator, TalkBack, etc.). Therefore, a special attention should be given to content language, structure and linearization, and navigation. Furthermore, it is crucial to add Alt text and audio descriptions to graphic elements that can't be read or described automatically by screen readers like non-decorative images, tables, diagrams, videos, etc. It is also recommended when writing Alt text, to keep it short and descriptive, the added information should consider the element purpose and also the surrounding text on the page. Alternatively, it is possible to convert documents to accessible epub and/or simple web pages, and to creating standardized eLearning content (SCORM) using specific tools and suites for learning management systems. Obviously, creating a fully universally accessible learning content aligned to Universal Design for Learning UDL guidelines represents the best approach to be adopted from the beginning (Constantopedos et al., 2020). Besides the accessibility of

learning content, online learning platforms and applications must in turn enable students using accessibility features and ensure compatibility with assistive technologies, which allows digital educational content to be presented properly in multiple ways fitting better the needs and preferences of visually impaired students (e.g. enlarging and selecting fonts, adjusting color contrast and display preferences, adapting page content, simplifying interfaces, eliminating redundant details, using Keyboard navigation, etc.).

Accessible Open Educational Resources

As can be seen, all of the above approaches and strategies need time and competencies for educators and institutions to prepare and provide quality universally accessible learning content. Alternatively, to face such challenge, especially in times of emergency, accessible open educational resources have never been so urgently and broadly needed like these days (Huang et al., 2020) (Ben Brahim et al., 2017). Open Educational resources (OER) are "learning, teaching and research materials that reside in the public domain or are under copyright that have been released under an open license, that permit no-cost access, re-use, re-purpose, adaptation and redistribution by others" (UNESCO, 2019). Educators and students can avail OER as they encompass distinctive key characteristics, including the possibility of reusing and remixing. In the same vein, accessible open educational resources are aimed at breaking down content accessibility barriers and enabling freely shared accessible educational content meeting the needs of students with disabilities to increase their e-inclusion capabilities in educational settings (Zhang et al., 2020). In this context, as part of its endeavors to enabling equal opportunity for all to access education harnessing the power of inclusive ICT and the tremendous potential of OER, Mada has launched an accessible OER Hub on OER Commons, where accessible open educational resources are aggregated, curated, and managed through collections, and groups, and development tools. The Mada OER Hub will be of great interest to the community in Qatar and beyond to avail existing freely accessible digital content and to use it to support online learning for all including students with disabilities (Khribi & Al-Sinani, 2021).

AI-enhanced accessibility solutions

It goes without saying that the last decade has witnessed a tremendous rise of Artificial Intelligence AI being used in various fields all over the world. In the accessibility and education fields, advanced AI algorithms are being more widely used to enhance the learning experience for all providing solutions with better performance and capacity at a much lower price. Indeed, several AI based features and tools exist today and have been applied to accessibility domains (Dowdy, 2021). Some of the most visible examples of these AI features enhancing accessibility, especially for visually impaired and blind students, comprise the following (Caprara, 2019):

- Speech recognition allows to analyze video and audio content, and to identify speakers and recognize words they are saying through natural language processing algorithms. The technology is used for speech-to-text (STT) transcription, automatic captions, and translations (e.g., Microsoft AI for text description and captioning, translator, etc.), virtual assistants, and other speech user interfaces. Voice recognition

has also made it possible for the blinds to dictate and compose documents completely hands free (e.g., Dragon, dictation, Microsoft Word dictation, etc.).

- Voice Control allows to use voice access commands to control and interact with both devices and the digital content through AI natural language processing techniques (e.g., Google voice control in Android devices, Windows Cortana voice control, Amazon Alexa, etc.).
- Image Recognition and Automatic Alt Text, in case of non-existence of text descriptions for graphic elements provided by content authors, AI algorithms can examine images and generate dynamically alternative text that can be read by screen readers. (e.g., non-background image recognition in Microsoft Office).
- Text Processing & Adaptation, automatic adaptation techniques can enhance content accessibility for blind users. Adapting content by applying AI transformation techniques (e.g., link enrichment, image enrichment, and navigation enrichment) allow changing the structure of the content and enrich it (e.g., adjusting text based on reading level, adding element descriptions, etc.)

In addition to the features and examples stated above, many initiatives and endorsements programs are set to foster availing Artificial Intelligence technology to improve accessibility for the sake of persons with disabilities. The Endorsement Program of Mada (Al Thani et al., 2019) is designed to provide a launchpad for international/local established entities that already have ready-to-market ICT Accessibility and Assistive Technology solutions that require endorsement to access a broader market and specific institutions in Qatar and the Arab region. Mada has supported and endorsed several applications in the field of inclusive education, such as Class Quiz and Wonder Tree. In the same way, Microsoft has launched a specific program entitled AI for accessibility committed to harness AI capabilities to empowering persons with disabilities. In order to enhance accessibility in online education for visually impaired and blind students, many projects have been granted through Microsoft AI for accessibility program, such as I-Stem document accessibility portal, Improving braille literacy skills via gamification, and Automated generation of descriptions (Microsoft, 2020). I-Stem portal aims at remediating and enhancing accessibility of documents (including documents with complex layouts, STEM, etc.) by combining AI with human corrections through a dedicated remediation portal. Such automated remediation would help educators to get their materials aligned to the most prominent considerations of accessibility. I-Stem AI supports heavy math documents, and handles two-columns, headings, tables, and lists. The tool analyzes and converts to an accessible format that can be downloaded as text, mp3, docx or html (I-Stem, 2020). There are also other AI based tools for accessibility checking and remediation like Codemantra's accessibility Insight, which is an intelligent document processing platform that embraces machine learning to automate document accessibility production (Codemantra, 2021.), and AccessiBe which is a web automated accessibility remediation tool aiming at automatically detecting accessibility issues and remediating the content to some extent to comply with WCAG guidelines (W3C, 2018).

Braille innovations to support blind students

Braille is an alternative method for blind or deaf-blind people to read and write. Blind students are nowadays using a large segment of Braille electronic devices like refreshable Braille

display and notetakers. Blind students have faced several online learning challenges since the beginning of the Covid-19 pandemic as they were forced to deal with new online learning settings using virtual classroom tools and video calling platforms as well as various digital learning content mostly not accessible. Hopefully today things are getting better thanks to combined efforts of the community, educational institutions and technology providers that collaborated closely to make online learning more accessible for students with disabilities. In this context, Braille Institute of America centers e.g. have been providing online classes and services since schools closure. Visually impaired and blind students have been participating in live sessions with Braille Institute instructors by video or phone calls. Microsoft Teams platform is used for online classes, and students can participate and interact with their tutors and instructors using computer and mobile devices.

Additionally, advanced AI research is being conducted to computerize tutoring services for visually impaired and blind students using Braille. In this context, ObjectiveEd has obtained a grant from Microsoft's AI for Accessibility program, to develop Braille AI Tutor which is an innovative system aiming at enabling students to improve their braille literacy through a combination of speech recognition and engaging games (ObjectiveEd, 2021). The system is specifically designed to facilitate learning braille from home in a distance learning environment. ObjectEd can be included within online learning systems to be used by teachers and students. Braille AI Tutor is one of the technologies in the ObjectiveEd suite. A teacher creates his lesson using the ObjectiveEd web-dashboard, then Braille AI Tutor sends one word or sentence at a time to a refreshable braille display (Fig. 1), and the student speaks the sentence while reading the Braille words. Using Microsoft AI Speech Recognition, the student's speech is converted into text, and sent back to Braille AI Tutor to be compared with the original sentence to the text (Schulz, 2020).

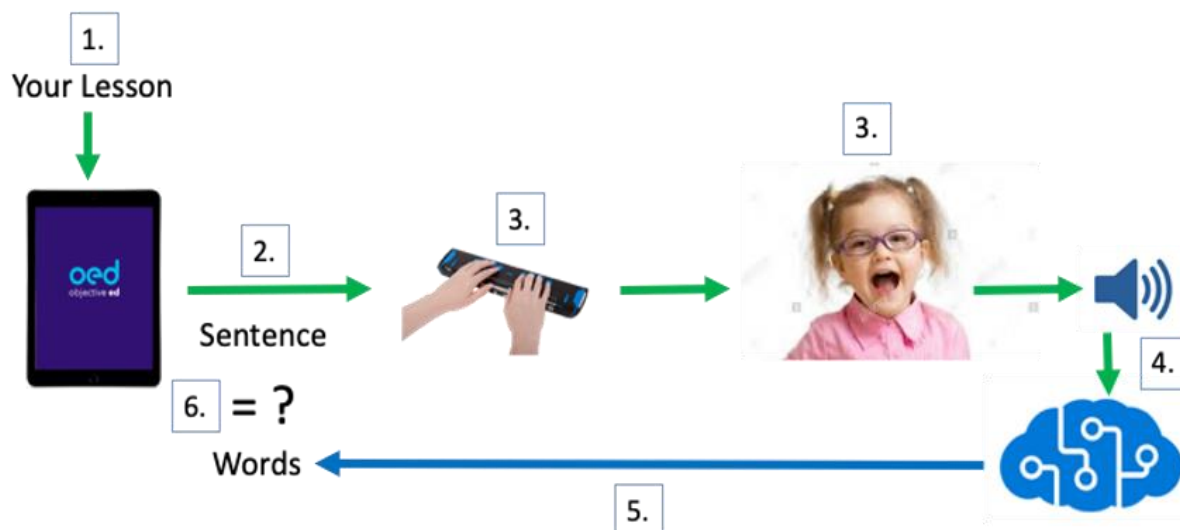


Figure 1. Braille AI Tutor

Equally important, in order to address the issue of limited number of braille cells displayed in a singular line in current Braille devices paired with computers, tablets, and smartphones, BLITAB Technology GmbH company created Blitab which is an Android tablet with 14 rows Braille display each with 23 6-dot braille cells (Fig. 2). The upper portion of Blitab is a multi-line braille display and the bottom portion has an Android screen (Brauner, 2017).

In the same way, PCT company developed Tactile Pro, a blind-only Tablet to print Braille and Braille drawings in real time, along with various applications such as editing documents, Internet, and games, as well as input and output devices for a Braille input and a Tactile Display. Tactile Edu is another product that is aimed at supporting Braille image education machine helping the visually impaired learn the braille and braille images by AI braille teacher bot's study guides (PCT, 2020).



Figure 2. Blitab: The Braille Tab

As studying STEM subjects is still challenging for students who are Braille readers, (Omone et al., 2021), many researchers endeavor to develop software and tools that can be used for accessing and transcribing text documents containing mathematical representations including equations, shapes, formulas, functions, etc. (Stone, 2020). in these circumstances. In this regard, a survey about the use of the Braille system in the Arab world conducted by Mada (El Ghouli et al., 2020) revealed a significant shortage of digital educational resources for the Arabic Braille system, especially in STEM subjects. Many problems were also reported regarding reading existing software capability to write and read in Arabic Braille. It is within this scope that Mada center launched the Unified Arabic Braille project, aiming at developing the Arabic Braille table used by assistive technology programs to input and showcase the braille method. As well as to develop the first 8-dot Arabic Braille computer table to support braille abbreviations in the fields of mathematics and science. Furthermore, Mada developed a web-portal containing a set of resources and lessons about Arabic Braille. The purpose of the portal is to provide accessible online learning content for blind and people who want to learn the Arabic Braille system.

Conclusion

Successful online learning experience for students with disabilities is mainly subject to the availability of appropriate technologies and accessibility, besides several other factors. The tremendous growth of technological capabilities and the widespread adoption of blended and hybrid learning models have opened the door to unprecedented learning opportunities for all students, including in principle those with disabilities. Nevertheless, the latter consideration remains contingent to what extent mainstream technologies in education are accessible and usable. This paper explored major barriers and difficulties impeding visually impaired and blind students to access online learning on equal footing with their peers and shed light on

potential solutions and avenues harnessing key technologies and accessibility to enable students getting the most out of educational technologies and better engaged and valuable learning experience.

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Thinkerbell Annie: World's First Self-Learning Braille Literacy Device – Winner of Mada Seedstars Award 2021

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Abstract

In 2016, a four-member team from Thinkerbell labs came together in building an innovative, accessible literacy braille device to make education inclusive for people with visual impairment. Developed by Thinkerbell Labs, Annie is a self-learning braille device that several visually-impaired students in school. Annie was built to be a comprehensive Braille self-learning device, one that could make learning fun, engaging, and intuitive for blind students. Furthermore, Annie was the winners of the Mada Seed stars Awards 2021 under Mada Innovation Program. In addition to it, Annie was designed to the learning experience prioritizing learner retention as well as sustained engagement with Annie's contents, be it from the software, content, or hardware perspective.

Introduction

Braille literacy rates across the world are abysmally low. The shortage of trained educators is one of the greatest impediments in the spread and adoption of Braille as learning the script involves heavy dependence on the special educator. The fewer the teachers, the harder it is for visually impaired children to get the attention they need for education truly beneficial to them (Wagh, Pragath and Suple, 2016).

Furthermore, the modes of teaching and learning Braille have remained surprisingly unchanged for several decades. Educational technology initiatives have often significantly changed how learning and teaching have been accomplished. Remote learning over the internet, for example, has been touted as a useful educational tool during the COVID-19 pandemic (McKenzie, 2021). However, these methods have faced criticism for widening the digital divide and not accounting for many sections of society - such as persons with disabilities - whose conditions of access to technology are different.

Identifying this problem and with a belief that Braille is a very self-learning process led to the birth of Thinker bell Labs in 2016. Annie helps in the early schooling of visually impaired students with its gamified audio lessons over Braille-based hardware. Thinker bell Labs' hopes to change the status quo by tackling these challenges via the Braille literacy device, Annie.

Background

Primarily, Braille is an essential system of learning for visually impaired people. It is the method which enables them to read and write (Lahiri et al., 2020). Various factors like lack of

government initiatives, limitations of tutors, lack of personal attention etc. are the possible reasons for this state. Mada Innovation Program aims at supporting the development of a self-learning Braille device which can help people with visual impairments. The solution aims at developing an easy to learn kit that will behave as a teacher and assists the visually challenged people for learning the Braille learning system. The designed system uses a Braille keypad and microphone to take input and produces speech as output. By implementing the designed system for visually challenged individuals, Braille literacy can be affected positively. The solution is so designed that it optimizes cost and speed of operation of the device.

Journey of Thinkerbell Annie

In 2014, Sanskriti Dawle and Aman Srivastava, co-founders of Thinkerbell Labs and then-students at BITS Palani, Goa Campus, conceptualised Annie. Made with a Raspberry Pi and coded in Python, Annie started as a simple prototype with a single Braille cell and an alphabet song. The last 7 years were spent listening to stakeholders involved and continuously innovating to ensure Annie solved the most pressing issues related to Braille learning. Now it's a comprehensive Braille learning device, with students being able to learn reading, writing, and typing through interactive lessons in over 10 languages across Grade 1 and Grade 2 braille.



Figure 1. Braille Learning device Annie by Thinkerbell

Today, Annie is a UNDP (United Nations Development Programme) best practice and has been commended by top policy and visual rehab organisations in India and was even applauded by the Prime Minister of India. Annie's help over 1000 children across 5 countries learn Braille more effectively (Bora G, 2019). The past 7 years has seen Annie and Thinkerbell Labs grow in many ways, and as they continue to expand across regions, they're set to grow even further (Wagh, 2019).

Annie is the world's first self-learning Braille literacy device. The technology behind Annie is designed to empower the learner to engage with Braille learning materials in their native language on their own, without the need for constant attention from a teacher. It is an effective self-learning tool for reading, writing, and typing in Braille that allows learners to take their time with their lessons and practice until they're satisfied with their work.

The device consists of two Braille displays for learners to read their lessons and play the gamified exercises on – a Large Braille Display, whose two cells have larger-than-usual dots, to help beginners easily read the script, and a Standard Braille Display, consisting of a row of six standard-sized Braille cells. There is a standard Braille keyboard consisting of six keys (corresponding to each of the dots in a Braille cell) to learn typing on, a digital Braille slate – the first of its kind – that can be used with a standard stylus to learn writing on, and navigational keys for device manipulation. Furthermore, the device has speakers and a headphone jack for the learner to absorb the auditory elements of Annie, such as in-exercise instructions. Annie also closes the long and arduous feedback loop on exercises by allowing children to learn from and practice on the same device, providing instantaneous feedback (Putrevu, 2019).

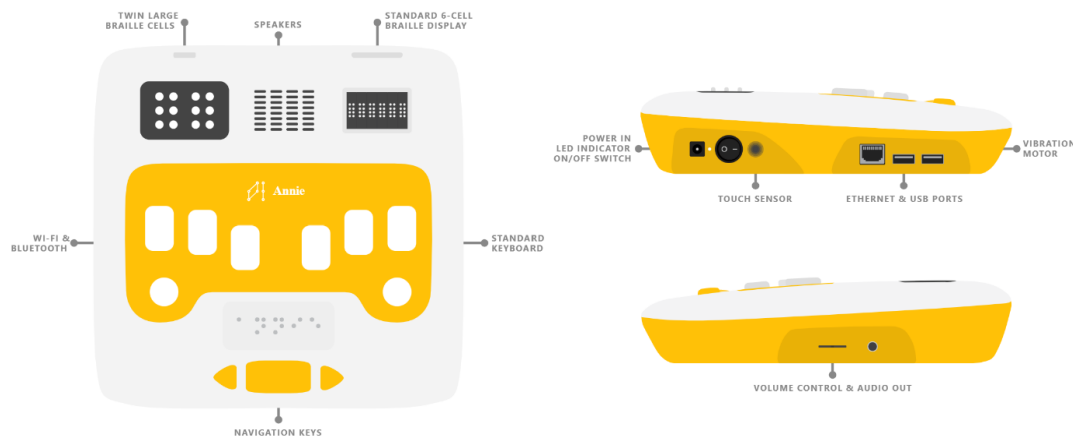


Figure 2. Technical Features of Annie (Wagh, 2016)

Annie's interactive pedagogy is established based on two aspects. First, that Annie is, after all, meant to help children, who like to play and learn from their surroundings, compete with their peers, and can get frustrated in the mundanity of a classroom. Secondly, that the learning ability of visually impaired children is limited not by their disabilities, but by the conditions of their education and the often-outmoded forms of engagement with Braille – engagement that sighted children often have ready access to. Therefore, Annie's gamified and interactive lessons guide learners to consistently practice and improve their Braille skills through touch and sound. Integrating Annie into the classroom experience has been essential to establishing an effective learning environment for both learners and teachers. This led to the conceptualization of Annie Resource Centres and Annie Smart Classes. An Annie Smart Class is ideal for a special school and consists of multiple Annie's set up in internet-enabled classrooms that could be supervised by teachers, allowing for collaborative and competitive learning on Annie.

An Annie Resource Center is a smaller version of an Annie Smart Class and is ideal for an inclusive school with fewer visually impaired children. Both the setups are holistic learning ecosystems thanks to the learning management system Helios that works in tandem with Annie. Helios empowers teachers to track their students' performance, plan their lessons, and therefore break the barrier of teachers needing to pay individual attention to students. This also allows for parents and administrators – many of whom might not know Braille themselves – to understand the learning journey of the children through a shared platform and play an important role in it.

Mada – Seedstars ICT Accessibility Awards 2021

Furthermore, Mada partners with Seedstars to promote the ICT Accessibility Solutions with the goal of supporting Accessibility startups in Qatar and beyond to benefit and improve the lives of PWD. Seedstars and Mada share a common vision to support innovation by working with the best startups in the field and offering them with suitable funding and subject matter expertise. The prize money is utilized for enhancing the innovative winning solution and a marketable product to effectively impact the targeted users.

Following the success of Mada ICT Accessibility Award on Virtual Seedstars Global Summit 2020/21, Mada continues to collaborate with Seedstars to enable startups to develop impacting solutions to improve the lives of PWD. For this year's award, 4 finalists were selected to pitch in Seedstars Regional Summit and subsequently, from which 2 finalists were chosen to advance to the final round and pitch in the Seedstars Global Summit that was held virtually on May 20, 2021. Thinkerbell Annie was the winner of Mada Seedstars Award 2021 (Mada Center, 2021).



Figure 3. Mada Seedstars ICT Accessibility Awards 2021 – Thinkerbell (Mada Center, 2021)

The announcement took place during the Seedstars Global Summit 2021 on May 20, 2021, which was a 2-hour event held virtually due to the travel and gathering restrictions imposed because of the COVID-19 outbreak.

Conclusion

Coming to future, Annie, which currently supports 7 languages (English, French, Spanish, Hindi, Marathi, Kannada, and Telugu) is working on more vernacular content in regional as well as international languages including Arabic. Furthermore, Annie have seen initial traction in the UK and the Middle East and have plan to grow the footprint in these geographies in the coming time to ensure that any student with a disability can learn at the same level in an

inclusive mainstream setup. Mada Intent to extend its support through Endorsement program for Thinkerbell Labs in bringing Annie to all visually impaired students in mainstream schools as well.

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Review of Robotics Systems Available to aid Visually Impaired Persons

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Abstract –

The need for assistance robots has risen dramatically in this time of age for persons with disabilities particularly for visually impaired persons as their number continues to rise. For them independent living can be performed by an aid robot which is one of the key assistive technology devices that can help to regain dignity and self-confidence. This paper reviews the existing design and development of a personal assistant robots that uses a certain scientific algorithm to detect and estimate the relative location of an objects in an indoor environment using voice instructions. These semi-humanoid robots have built in multiple HD cameras located on different parts of the robots. Autonomous movement, object detection, distance measuring, and motion planning are all done with the cameras. Furthermore, the robot's utility is increased by keeping the user informed about the results of its actions.

Introduction

The number of visually disabled individuals is rapidly increasing in tandem with the overall population growth. According to the World Health Organization, there are over 2.2 billion people are blind or visually impaired (WHO, 2021), among which 36 million people are blind (Albogamy et al., n.d.). Vision loss is a common and unpredictable occurrence and the safe navigation in everyday life environment is one of the most important challenges. To tackle this problem there are two common types of assistive technology devices for in-door and out-door navigation.

Outdoor navigation devices are generally relying on Global Positioning System (GPS) technology. Some systems like the white canes with GPS functionality and the use of guide dogs are widely available for the persons with visually impairments to assist with detecting objects, mobility and travel in both in-door and out-door environments. However, in many cases particularly in the middle east region blind and visually impaired people are heavily relying on others' assistance to perform their daily tasks. Advance Artificial Intelligence technology and deep learning devices have been developed over the recent time to aid with the ability to detect objects in the surrounding environment, to develop an alert system for daily living smart aids and medication schedule, suggest possible routes and to recognise faces and object. This kind of recognition process uses facial and objects recognition technology similar the one used in the smart phones. Hence robots' systems have been developed and made available taking the advantage of these advances in technology to aid persons with visually impairment.

Assistive Robots for Mobility

For sighted people, GPS-based systems have increasingly become effective for outdoor navigation, however indoor navigation remains an open problem. Sighted people can easily rely on visual cues to get to destinations in large buildings such as shopping malls and airports, but for blind people, indoor navigation is a major challenge (Feng et al., 2015).

Robots developed to help with in-door navigation through voice commands and object recognition using cloud API. These robot devices are geared up with a visual sensor using HD multi cameras, laser range finders, speaker, gives visually impaired humans statistics approximately the surroundings round them. Recorded laser data are analysed the use of the clustering technique, making it feasible to discover obstacles, steps and stairs (Fig 7). By way of the use of the visual sensor, the system is capable of distinguish among gadgets and people. The built-in processors analyse the sensors information and convey records to the visually impaired humans by means of natural language or beep sign.



Figure 1. A blind lady walks with the robot as sighted guide

In addition, other types of physical robots are trained with various objects in the indoor environment, it sends voice commands to the robot via Google Assistant to find the objects the user needs. Using voice commands, the physical robot finds the target object and the reference object, and successfully provides the necessary relative position of the object to the user (Fig 8). In general, physical robots act as personal assistants for the visually impaired indoors.

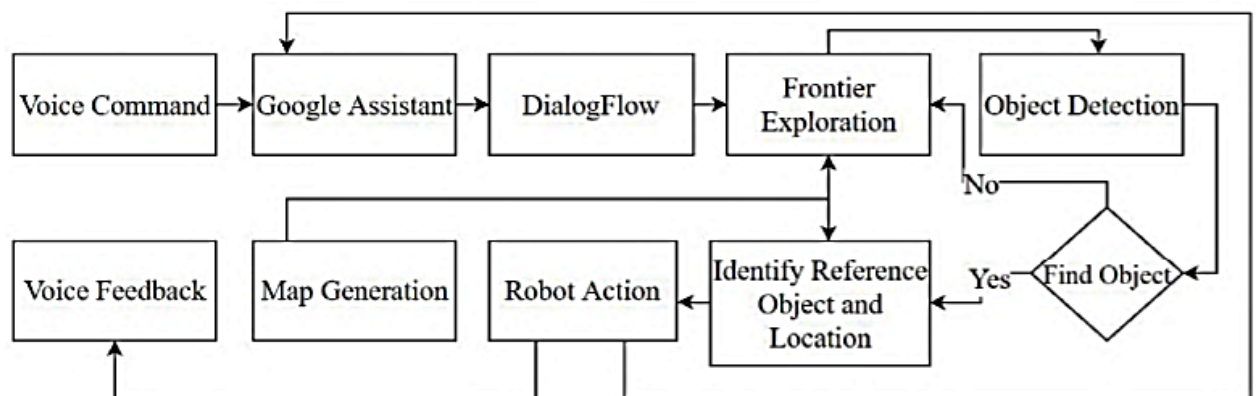


Figure 2. A typical model of assistant robot system flow to detect object via voice command

Autonomous AI Robot

This robot has been developed by University of California ("Mini Cheetah - ROBOTS: Your Guide to the World of Robotics", 2021) which known as Mini Cheetah. It has four legs and equipped with a laser mapping system, cameras, and sensors to safely guide the visually impaired people out-doors. This autonomous AI robot could safely guide its handler through difficult and narrow streets which has many barriers just like a real guide dog (Fig 9). Mini Cheetah can also plot the shortest route for the visually impaired and blind people, reducing travel time and scanning the path with the fewest obstacles.

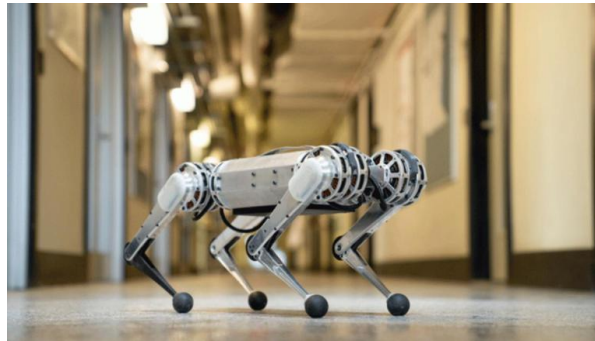


Figure 3. Mini Cheetah AI Autonomous Robot

Guidance Robot

This robot is in use at the Kanagawa Rehabilitation Hospital, Japan for the purpose of guiding visually impaired and blind patients. Depending on the force with which the person with visually impairment pushes on the robot, it navigates to its target while guiding (Tobita, Sagayama & Ogawa, 2017). In a barrier-free setting, such as hospitals, the robot should securely accompany visually impaired people to their destinations. As a result, the moving mechanism with wheels, localization, path generation, obstacle avoidance, voice announcements, and an input interface that is not dependent on visual sense are all design criteria for the robot (Fig 10)



Figure 4. Guidance robot for visually impaired and blind patients in Japan

Conclusion

There are several projects and manufactures who have explored the use of robots to replace blind people's personal mobility aids or personal assistants following the successful new trend of technologies such as handheld devices such as radar equipped white canes, wayfinding technology and robotic walkers for older blind people with mobility challenges. However, with the recent development of AI, IoT, cloud technology, 5G and robotic systems, a new approach has been adopted by technology providers to build a new robot that have the capability to overcome the challenges that facing visually impaired and blind people in their daily life and activities. These robotic systems are very smart, and they can be trained and customised for certain individuals or ideally can be in public service areas such airports for multi-users and multi-purposes.

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Innovative ICT Accessibility solutions in stadiums and fan zones for persons with visual impairment and blindness

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Abstract –

The present article discuss how innovative solutions can be utilized in the fan zones to ease and improve the overall experience for persons with visual impairment and blindness. First, it will examine how wayfinding solutions can help persons with disabilities navigate through unfamiliar spaces. Second, it will showcase innovative solutions that allow fans with disabilities to enjoy the match through tactile feedback. Lastly, it will discuss how the overall audio commentary can be more accessible for fans.

Introduction

With the approach of the World Cup 2022 [™] in Qatar, many fans can expect immersive fan zones to watch live matches. With that, it is imperative to ensure that fans with disabilities and the elderly can fully enjoy the live matches in stadiums and in fan zones. Stadiums are a large enclosure that allows football matches, and large seating capacity for fans and spectators (Zetlin, 1999). In accordance with the Americans with Disabilities Act (ADA) of 1990 (Americans with Disabilities Act, 1990), and the Web Content Accessibility Guidelines WCAG 2.1 (WCAG 2.1,) stadiums that are classified as accessible, need to comply with the key features in physical and digital aspects to all types of disabilities.

Whereas fan zones encompass a different scale of match viewing, it considers fans that were not able to be a direct part of the stadium experience and instead can watch the live matches in conjunction with other fans (El-Sayed, 2013). In addition to live watching the match, fan zones include variety of activities that invites the fans to participate in, such as: “live performances, refreshments and food, children-friendly games and activities, shop units, meet the team areas for guest appearances, experiential activities” (Rapidretail, 2018). For fan zones to be fully accessible and effective for persons with disabilities, it needs to be designed as a complete user journey, considering how accessible each activity is. Figure 1 shows the workflow of a user journey in a fan zone (Dickson et al., 2016).

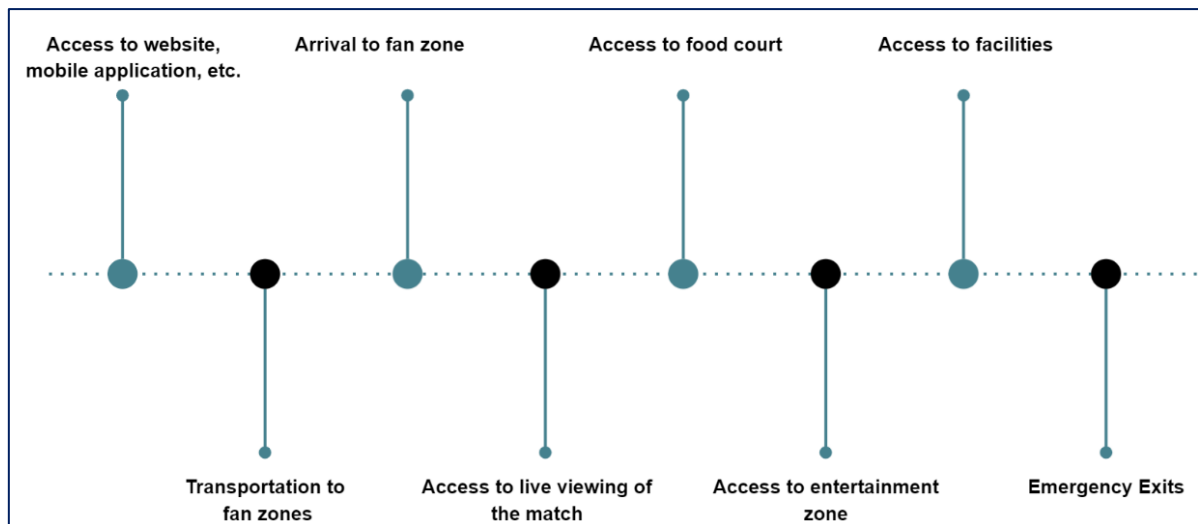


Figure 1. User journey in fan zones¹

Wayfinding Solutions

Wayfinding solutions are created to provide geospatial route technologies. Entering an unfamiliar environment could pose a navigational challenge to persons with disabilities especially persons with visual disabilities (Balata et al., 2015). To provide wayfinding solutions that operate for persons with disabilities requires various components such as audio guide assistance, accessible UI interface, and consideration for navigation barriers. That is why it is integral to provide accessible key and specific information to persons with visual impairment to ease the process of navigation in fan zones and promote independent living. Fortunately, with the rise of advancement in wayfinding technologies, users with disabilities can easily navigate indoor and outdoor spaces using their smartphones. Fan zones include a variety of pathways and landmarks that needs to be shared with persons with visual impairment in an accessible manner. For instance, in the FIFA Club World Cup Qatar 2019 – Alibaba Cloud, the location map of the fan zone included a variety of marked locations as shown in Figure (2) such as Prayer Rooms, Medical Care, Accessibility Platforms, Shuttle Buses, Ambulances, Information Desk.. etc (Club World Cup Qatar 2019 Fan Zone - Presented by Alibaba Cloud, 2019). These landmarks could lead to confusion and frustration to persons with visual impairment if they were not displayed in an accessible digital format.

¹ reproduced from Dickson, T., Darcy, S., Johns, R., & Pentifallo, C. (2016). Inclusive by design: transformative services and sport-event accessibility. The Service Industries Journal, 36(11-12), 532-555. <https://doi.org/10.1080/02642069.2016.1255728>



Figure 2. Location Map of the FIFA Club World Cup Qatar 2019 (Club World Cup Qatar 2019 Fan Zone - Presented by Alibaba Cloud, 2019)

Lazarillo Wayfinding Solution:

As part of the Mada Innovation Program, use cases were presented to promote innovative solutions. One challenge presented was the “Implementation of a Wayfinding system to support People with Visual Disabilities”. The issue statement was that there were depleted resources on indoor wayfinding systems which means that most people with visual disabilities are unable to extend the functionality of GPS to buildings, leaving them without any navigation support. Hence, Mada has supported Lazarillo² wayfinding solutions through different competition stream. In Seedstars Global Summit 2020, Mada Center has awarded Lazarillo with the Mada ICT Accessibility Awards 2019 to promote ICT Accessibility Solutions on an international level. Lazarillo is a free smartphone application that provides an autonomous guide for persons with visual impairment using Bluetooth beacon technology. There are several highlighted features in the Lazarillo application that would ease the overall experience for persons with visual impairment in fan zones such as:

- Recognize current locations through voiceover & customize exploration journey
- Search for different destinations and get precise location on how to get there
- The Lazarillo application is available in IOS & Android and in 25+ Language

Live Commentary

Tactile feedback and headsets are used in a live commentary to ensure equal access to instant news of the Football match. During a live match, it is difficult to receive an audio description of the status of the game, instead, abled fans depend on multi-senses to keep up with the

² (To learn more about Lazarillo solution: <https://lazarillo.app/>)

game. As such it is vital to create accessible live streaming content for fans with visual impairment. There are various innovative solutions in the market that promotes inclusivity such as:

Footbraille

Footbraille is a haptic technology that allows users with visual disabilities to track the exact location of the ball through a touch-based table ("Footbraille Digi Merdeka Campaign 2019", 2019). The Footbraille is designed by Digi, Mojo Films, and in collaboration with Naga DDB Tribal Malaysia in 2019. The Footbraille utilizes custom software that automatically detects and syncs the football match to allows users to "feel" the match (Brohier, 2019). The Footbraille works by allowing users to place their hand on carpeted device that mimics the football field pitch. During the game, a miniature ball moves in sync with the game match therefore fans can easily track the game status. As of now the technology is being developed as a prototype and has been launched in sport events in Malaysia. In the upcoming development phase, Footbraille aims to instantly sync the matches with live matches, and training videos (Brohier, 2019).



Figure 3. User experience of Footbraille (Brohier, 2019)

Accessible Live Match

Watching a sports match engages various senses, for persons with visual impairment, it is important to make sure the information relayed is accurate and precise. To provide an inclusive experience, the commentary for live matches should include the following:

- **Headsets Assistances:** Noise in the fan zones can distract users with a visual impairment from listening to accessible information, that is why fan zones can promote inclusiveness by offering headsets to fans. An example of innovative

solutions is Unite Headsets by Beyerdynamic. The headsets allow equal participation to persons with visual impairments to listen to the match. The headsets have various features (Beyerdynamic, 2021) such as:

- High operating range and high volume that can be individually adjusted.
 - Co-presenters and monitoring are possible.
 - The transmitters balance out voices of varying volume or block out disturbing background noise.
 - Unite transmits signals up to 300 metres free-field
 - Unite can transmit foreign languages and assisted listening for those hard of hearing
- **Audio-Descriptive Commentary:**

Audio-Described commentary is unique set of service that provides fans with descriptive entail on the match. Partially sighted and blind fans can miss out on important highlights of the match during the fan zone due to relaying missing information. According to Centre for Access to Football in Europe, "The specially trained commentator provides additional narration that describes all significant visual information such as body language, facial expression, scenery, action, clothing, colours and anything else that is important to conveying the image, venue, match, event or surrounding ambience. During the match, the commentator should describe the on-pitch action rather than talking about statistics or tactics or providing lengthy summaries of previous action." ("About Audio-Descriptive Commentary", n.d.).

Conclusion

All in all, it is clear that many initiatives are addressing the gap in persons with visual impairments experience in stadiums and fan zones. With the use of digital solutions, more fans are able to fully experience the football experience through assistive technologies. However, with that being said, the challenge is now to fully implement the innovative solutions in stadiums and fan zones at a larger scale, such that every stadium is equipped with the solutions.

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Mada Accessibility & AT Glossary



يعد قاموس مدى أول قاموس من نوعه لمصطلحات النفاذ إلى تكنولوجيا المعلومات والاتصالات والتكنولوجيا المساعدة باللغة العربية حيث يعتبر مصدرًا معتمدًا وحيويًا للمفاهيم والمصطلحات التي تخدم الفئات المستهدفة والمبتكرين والباحثين وغيرهم.

تم اعتماد ترجمة هذه المصطلحات من قبل معهد دراسات الترجمة في جامعة حمد بن خليفة.

للإطلاع على القاموس تفضلوا بزيارة: glossary.mada.org.qa

Mada's Glossary is considered the first dictionary of its kind, which includes terminologies relevant to ICT, & Assistive Technologies in the Arabic language. It is considered a vital resource for terms that serve experts, innovators, researchers, and others.

The translation of these terms has been accredited by the Translation and Interpreting Institute at HBKU.

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Unified Arabic Braille Portal by Mada: Innovative digital resource to reduce braille literacy in the Arab region

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Abstract –

Given the rise of audiobooks, does braille still have a role to play in the lives of people who are blind or visually impaired? For people who are blind, knowing Braille is the equivalent of knowing to read and write print by someone with sight. It is a unique system of raised dots that can be read by touch. Learning braille means that blind and partially sighted people can enjoy reading for life. Learning braille from a young age helps with literacy, as braille is a much better way to understand punctuation, grammar and spelling than audio (Rex et al., 1994). It is a method of reading and writing that relies on touching prominent dots that the blind recognizes once they pass their fingers over them. The method was invented in the mid-19th century and got its name from the name of its French founder Louis Braille (Mellor, 2006). This paper presents an overview about the Unified Arabic Braille Project which was supported and developed by the Mada Innovation Program.

Brief about Braille

Braille helped blind children to learn how to read and write and adults who lost their ability to read, due to blindness or vision impairment, continue to enjoy access to books, magazines, and other knowledge resources. Braille is not a language, as some call it, but it is a code that enables blind people to read and write in different languages such as Arabic, English, and French. It is worth mentioning that braille in Arabic is read from left to right and not the opposite as it should be in Arabic text, this is to be in line with the braille reading format of all languages (Foulke, 2013).

In 1892, Louis Braille published a book explaining his method, but his new method initially faced strong opposition from officials of schools and institutes for the blind – even at the school where he worked (Bullock et al., 2009). The blind was learning braille outside of formal school hours. This remained so until France officially adopted braille in 1854, two years after Braille's death, thanks to his students who fought for the adoption of this method. The braille method then moved to different languages of the world, for example, it was first used in the United States in 1860 and Britain in 1868. Braille then was available for Arabic in 1951. The braille method was read in the Arab world from right to left, but after the invention of braille printing machines, all machines were imported and printed from left to right, a general conference was held for organizations caring for the blind in the Arab world to decide to read braille from left to right (Bintaleb et al., 2020).

Braille continued to evolve in terms of both the font and the means of reading and writing. At the font level, the writing method has appeared with abbreviations in all languages, including Arabic, a method that relies on writing one or more words in one or two cells. Abraham Nemeth, a blind mathematician, created the Nemeth Braille Code to write mathematical problems and equations in a unified global style. Recently, computer braille has appeared, which depends on an 8-dot cell instead of six, to accommodate a greater number of signs and symbols, especially computer signs.



Figure 1. Unified Arabic Braille Portal by Mada (<https://braille.mada.org.qa>)

In terms of braille reading and writing tools, here's when the most prominent braille tools appeared:

- In 1951, David Abraham, a woodworking teacher at Perkins American School for the Blind, designed and produced the Perkins paper writing machine, which is still popular to date.
- In 1971, the first braille printer appeared to print computer text on braille paper.
- In 1975, the German University of Dortmund produced the BRAILLEX device, the first device to contain an electronic braille display.
- In 1976, Duxbury Translator was first installed at the Canadian Foundation for the Blind and was the first commercial program to convert plain text on a computer into braille dots, for use by printers and braille displays.
- In 1982, the first electronic braille display called VersaBraille was launched in the United States of America by Telesensory, a device that displays the text written on a computer screen in braille on an electronic braille display.
- In 1987, Braille 'n Speak, the first portable electronic braille notebook to feature a Perkins-style braille keyboard was launched. The great success of this device at that time opened the door for the development of the electronic braille notebooks used today.
- In 1995, Duxbury for Windows was launched, making braille translation available on the Windows operating system.
- In 2004, HumanWare released the Brailiant, the first electronic braille display that could work via Bluetooth.

Challenges and Advantages

Considering the development of digital technology to access content audibly, such as the screen-reading programs on all computer and smartphone systems, some argue that braille has now become a less important tool for the blind. However, this is not true. More than 150 million blind people around the world still use braille for many reasons. Perhaps the biggest aspect of the importance of braille lies in the literacy of the blind person, in this way they can learn the spelling of words and punctuation and visualize how the text is formatted on the page (UNESCO, 2005).

Audiobooks and other audio media have provided a valuable additional source of learning. Despite that listening is not the same as reading, studies have shown that students who master braille have more reading and writing skills than their peers who do not master braille (Toussaint et al., 2010). Furthermore, braille's importance includes the career aspect. A survey conducted by Louisiana Tech University showed that blind people who can read braille have greater chances of employment (Bostick, 2016).

It is worth noting that braille has also achieved its share of technological development, as technology has facilitated access to braille and become portable in small-sized devices, thanks to electronic braille notebooks and programs that convert plain text into braille, and braille displays that are used with computers. As noted earlier, braille is the only method by which a person who does not have access to printed material can read and write, some of the aspects and areas in which the blind use braille are:

- Reading the Qur'an: Using only braille, the blind can recite the Holy Quran whenever they want. Many institutions provide copies of the Holy Qur'an in braille.
- Careful reading: braille allows the blind to read and examine books and courses in a way that gives more focus on content than listening to audio.
- Learning new languages: One of the areas in which blind people benefit most from the braille method is when they want to learn any new language, especially when it comes to learning the alphabets, words spelling, and sentence structures, this is also useful for training in reading in that language and repeating what is read.
- Taking notes during meetings or lectures: Braille, especially electronic diaries, allows the blind to take notes while in a lecture or meeting, without disturbing others and without distracting themselves by listening to the screen reader program.
- Spell Check: In braille only, the blind can check the texts for spelling and detect writing errors, such as extra spaces and errors related to punctuation, which cannot be achieved by listening to the text. Through this feature, the blind can work in jobs that depend on careful examination of written texts, such as proofreading, translation, paraphrasing content, and programming.
- Providing presentations and lectures: Braille allows the blind to speak to the audience and present lectures, presentations, or explanations in braille to the audience.
- Working with media and audio reading: Braille allows the blind to work in media such as radio and television and allows them to read news and present programs. Braille also helps the blind to work in the Voiceover area.
- Work in jobs that require textual content follow-up: Such as working in customer service centers and company call centers, where the blind can use braille to read what needs to be explained to the customer.

- Perform mathematical processes, especially complex ones.
- Reading the signs displayed in braille: In some countries, the indicative signs are displayed in braille on an equal basis for the blind compared to their sighted peers.
- Learn about food menus in restaurants that provide them in braille: The blind can identify the menu without the need for someone else to read it for them.
- Enjoying games: Blind people can enjoy many types of games by writing on them in braille alongside regular writing, and then they can play these games with each other or with the sighted as well. There is no doubt that this contributes to the greater integration of the blind in society. It is worth noting that there are many companies and websites that sell such games to the blind.
- Knowing medications: Many pharmaceutical companies today print the name of the drug on the package in braille, and thus, the blind can identify the type of medicine directly by reading what is written on the package.
- Labels: Some blind people write in braille on stickers and then put these stickers on the tools or things they always use to easily distinguish them from others and identify them later.
- Writing, memorizing, and reviewing musical notes.

Unified Arabic Braille Portal by Mada

The aim of the Unified Arabic Braille Portal by Mada Center (Figure 1), is to develop the Arabic Braille table used by assistive technology programs to input and showcase the braille method. As well as to develop the first 8-dot Arabic Braille computer table to support braille abbreviations in the fields of mathematics and science. Braille is the only way that enables blind or deaf-blind people who have difficulty accessing printed materials to read and write using assistive technology. The project will benefit the blind, deaf-blind people, experts, teachers, students, software developers, and assistive technology manufacturers in Qatar and beyond.

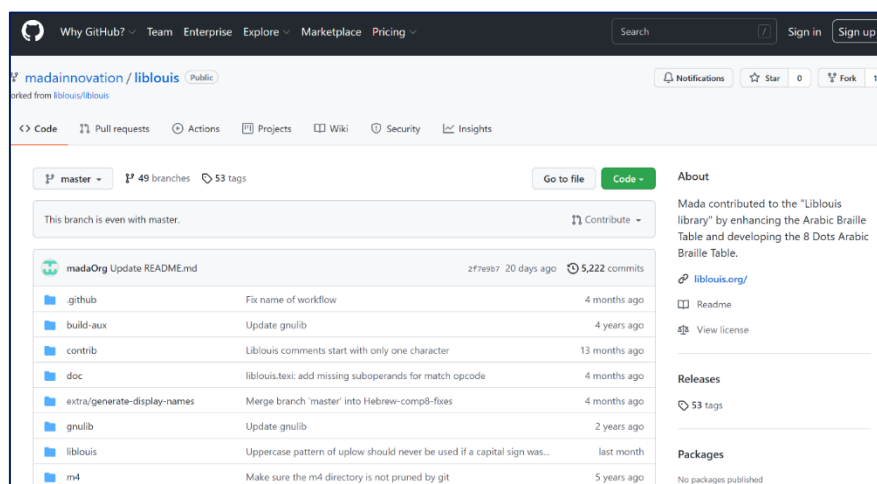


Figure 2. Upgraded Liblouis Library on Mada's Github repository
(<https://github.com/madainnovation/liblouis>)

The Unified Arabic Braille Portal (braille.mada.org.qa) (El Ghouli et al., 2020) is supported by the Mada Innovation Program (MIP) (Al Thani et al., 2019). It provides the first Liblouis

software library based on the Arabic Braille table to develop braille writing and reading skills for blind and deaf-blind people [ref] (Figure 2). Furthermore, create the first specialized Unified Arabic Braille website, which will contain detailed references to simple Arabic Braille, abbreviations, mathematics and science, and 8-dot computer braille, in addition to simplified lessons to learn reading and writing in Arabic Braille.

The Unified Arabic Braille was started from the Arabic Braille Reference adopted during the Braille Conference held in Riyadh in 2002. Since 2002, the Arabic Braille was not updated in where Blind persons found difficulties to use the latest innovations and assistive technologies. Nowadays, the upgraded Arabic tables were adopted by screen readers like NVDA and JAWS in addition to accessible books format using DAISY for example (Egli, 2009).

Moreover, the Unified Arabic Braille portal contains a set of resources and lessons about Arabic Braille. The purpose of the portal is to provide digital contents for blind and people who want to learn the Arabic Braille system. The portal also provides a platform to discuss issues and propose new features for the current system. It represents the first specialized Unified Arabic Braille website, which contains detailed references to simple Arabic Braille, abbreviations, mathematics and science, and 8-dot computer braille, in addition to simplified lessons to learn reading and writing in Arabic Braille. Also, Mada Center published the Mada ICT Accessibility and Assistive Technology Glossary (Lahiri et al., 2020) to support and unify the learning activities for Blind students. It is the first dictionary of its kind, which includes terms related to ICT accessibility and assistive technology (AT) in the Arabic language. The Glossary was developed to serve as a vital resource for capacity building within ICT services, accessibility, and assistive technology in Qatar and beyond. Mada's Glossary is essential to educate professionals, researchers, and individuals interested in the basic terms used in these fields. It is considered one of the first initiatives to provide such resources in Arabic.

Conclusion

Reading and writing in braille have opened the door for the blind towards literacy, intellectual freedom, equal opportunities, and greater privacy and independence. We should not direct children who can read not to learn the alphabet just because they can watch the video instead, as this will undoubtedly be considered a serious deficiency in the educational process. So why do we allow ourselves to use different standards with blind people that prevent them from having the true pleasure and feeling of reading? Braille materials are no longer as big and expensive as they used to be, they have been involved in technology too. A single book, which needed several, large volumes to be printed in Braille, can now be easily carried by the blind person in their electronic diary along with dozens of other books. It is our imperative duty – institutions and individuals – to work hard to spread knowledge among the blind, and to strive in various ways to eradicate the illiteracy of many people who cannot read and write using braille, by facilitating access to it and overcoming all obstacles that may stand in the way of those who wish to learn it.

Mada played a role on supporting the development of the first portal for the Arabic braille to unify all efforts in one place. Persons with visual impairment participated in the feasibility study of the project in addition to the adjustment of the liblouis library. They were contributed in the project directly to ensure that they can benefit of it.

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