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Overview of Arabic TTS and related Technologies

Research Efforts on Arabic TTS in the state of Qatar

The unified Arabic Braille Portal by Mada

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Overview of Arabic TTS and related Technologies

Mada Center

Nowadays, electronic devices are more able to output information in the form of sounds, which makes them more able to interact with humans. As Talking devices gain a prominent place in our daily lives and especially for persons with disabilities, it is increasingly important that these technologies have a speech capability similar to humans. The perceptual quality of the outcome of Text to Speech (TTS) software affects how well a person accepts these systems. For this reason, researchers on the domain of TTS are striving to make artificial speech more natural. In the market there exist several number of TTS systems that varies on quality and technology.

As an assistive technology, text-to-speech (TTS) software is designed to support people who have difficulties reading written text. Common reading disabilities can include blindness, dyslexia or any visual impairment, learning disability or other physical condition that impedes the ability to read. However, other persons can benefit from TTS technology, such as autistic children, attention deficit hyperactivity disorder (ADHD) or persons with intellectual disability.

“Festival” is one of the most common TTS frameworks that uses Hidden Markov Model based speech synthesis technology. It offers several tools and resources for making text to speech synthesis software. The framework includes examples of various modules. It allows making full text to speech applications through a set APIs: Scheme command interpreter, C++ library, Java Packages, and an Emacs interface. “Festival” is multi-lingual, and currently it supports English and Spanish. Other groups release new languages for the system. Many Open-source Arabic TTS are created using “Festival” and are available on “GitHub” for free.

“Sakhr TTS” is the industry leader in synthesizing a natural, human-sounding Arabic voice. Sakhr provides software for Arabic Text-to-Speech (TTS) and Automatic Speech Recognition (ASR). The TTS converts Arabic text into a natural synthetic voice. In developing its software, Sakhr is leveraging 28 years of research and development in Natural Arabic Language Processing (NLP). This research is considered critical to

overcome the Arabic text-to-speech challenges, such as the lack of accents and punctuation marks.

There are additional commercial engines such as “Amazon Polly”, “Google Tacotron”, and “IBM Watson Text to Speech”. Amazon Polly is a service that synthesizes speech from text, allowing developers to create talking applications, and build entirely new categories of speech-enabled software and products. Polly’s TTS engine uses advanced deep learning technologies to synthesize natural human-sounding speech. With dozens of lifelike voices across a broad set of languages. The standard voice of Polly supports Arabic language. However, Arabic is not yet included on the new Neural Text-to-Speech (NTTS) voices, which provides advanced improvements in speech quality through a new machine learning approach.

One of the top-rated TTS software is “Acapela”. Acapela is a High-Quality Text to Speech software. Acapela provides a large set of voices that cover 30 different languages including Arabic. Selected few voices can be purchased in special emotive versions that include multiple variations for different moods or perspectives. It also offers children’s voices. Acapella provides a large development kits for software developer covering mobile applications as well as desktop applications and cloud services.

Research Efforts on Arabic TTS in the State of Qatar

Mada Center

Text-to-Speech (TTS) technology uses automated speech synthesis to produce speech. TTS technology employs a speech synthesizer that converts symbolic linguistic representations into sound in conjunction with another solution (usually software) that parses raw text input and assigns its phonetic transcriptions by marking and dividing the text input into relevant words, sentences, and punctuations.

Over the past two decades, TTS has become a key area of interest due to its potential usage across various application areas like assistive technology and educational software consisting of multimedia output and relevant Interactive solutions. Likewise, the quality of TTS has significantly improved over time by sounding more like natural human voices. Following are the different aspects that measure the quality of a TTS output:

- **Naturalness:** the degree of the speech generated to be as close to a human-sounding speech in terms of its timing structure, pronunciation, and rendering of emotions.
- **Intelligibility:** the quality of the audio generated, or the degree of each word being produced in a sentence.
- **Preference:** a better liking by end-users of a particular TTS over other available alternatives; preference and naturalness are influenced by TTS system, signal quality, and voice, in isolation and in combination.
- **Comprehensibility:** the degree of the speech output being interpretable

Many advances have been made in Text-to-Speech Engine (TTS) over the past decade. TTS has played a major role in developing technologies for the blind and visually impaired, as it allows to read text from a screen display. Most research on TTS has been done in languages such as English and French, while many other languages, such as Arabic, have not been substantially worked on until the recent decade. The field of Arabic Text-to-Speech can still be considered to be in its early stages of development compared to other Latin languages.

Text-to-Speech Synthesizer Components

TTS Synthesizer comprises of two major components which are the Natural Language Processing (NLP) Engine and the Digital Signal Processing (DSP).

The natural language derived from the interaction between computers and humans is called **Natural Language Processing (NLP)** which is a branch of Artificial Intelligence. (NLP) reads, decipher, and interprets human languages which are commonly achieved through machine learning. There are four major components of (NLP) namely; Text Processing Module, Text Analyzer, Pronunciation Module, and a Prosody Generator.

Figure 1: Major components of NLP

The **Digital Signal Processing (DSP)** is the component of the TTS synthesizer that converts the list of phonetic transcription and their prosodic information into digital audio through mathematical models, algorithms, and computational methods to deliver a natural-sounding speech. The algorithm for generating the digital audio will vary based on the requirements, complexity, and technology used. DSP ultimately transforms symbolic information processed from NLP into speech.

Arabic Text-to-Speech Challenges

In addition to common challenges faced in the process of developing TTS solutions, Arabic TTS development poses additional significant challenges which are as follows:

· Diacritization

Arabic is a diacritized language with a complex diacritization system. Written Arabic text often omits the detailed diacritic properties of characters leading to the unavailability of key information about its accurate pronunciation to be performed by the TTS. The absence of diacritization is a source of confusion for computational systems that adds ambiguity to both text analysis and sound generation. Each character in an Arabic word must be assigned with diacritics that give the information about its accurate pronunciation. Additionally, the correct pronunciation of a word is not often obvious from its spelling and there will exist many words with multiple pronunciations based on the linguistic context.

· Dialects

Arabic is spoken in more than 23 countries by more than 300 million people worldwide. The large geo-demographic spread of Arabic speakers means that the language is

spoken by a socio-culturally diverse range of population with various dialects. The varieties in dialects impose a problem for speech synthesis as it would have to vary the speech output based on the pronunciations of the concerned dialect. Every dialect will have a relatively limited number of users from specific regions where the dialect is practiced. In addition to dialects, Arabic TTS systems may generate speech output in Modern Standard Arabic (MSA). However, MSA is understood primarily by individuals with relatively higher levels of literacy limiting the number of users who would use TTS supporting MSA language. Thus, the development of Arabic TTS will involve the creation of TTS systems that support multiple dialects and MSA all of which have a limited customer base on their own.

Qatari Research Efforts

ArabicProsody TTS – Intonation and stress generator for Arabic text-to-speech

A team from Qatar University contributed towards developing the **ArabicProsody TTS – Intonation and stress generator for Arabic text-to-speech system**. This research project involved the use of fine-grained linguistic analysis to help produce spoken output which was both intelligible and natural sounding from didacticized Arabic text.

A team from Qatar University developed a Natural Language Process (NLP) engine- which included a prosody generator- for converting Arabic text into a phonetically transcribed and prosodically labeled text. The prosodic generator is the final module of the NLP engine that derives the pitch information automatically. The (Multi-Band Resynthesis OverLap Add) MBROLA system was used which is a diphone-base synthesizer to produce the signal waves.

This TTS system is designed for Modern Standard Arabic (MSA). This system generates speech from unrestricted Arabic text by carrying on the following tasks:

- Assigning diacritics to the written text.
- Automatic phonetic transcription.
- Syntactic analysis in order to assign a global intonation contour.
- Calculating and producing the local pitch contours for sentences.
- Connecting the NLP engine with MBROLA synthesizer

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Mada Reviews: Accessible Gaming & Wonder Tree

Al-Dana Ahmed Al-Mohannadi, Shahbaz Ahmed
Mada Center

In cooperation with its partners, Mada Center works to identify the needs of persons with disabilities for assistive technology and digital access solutions in Arabic. The center has supported start-ups and entrepreneurs to localize technological devices and solutions through the Mada Innovation Program, with the aim of improving digital accessibility for PWDs at the local, regional and international levels.

In recent years, gaming has become increasingly prevalent with the advent of mobile gaming, gamification in the workplace and greater uptake of augmented reality technology by people of all ages. Gaming is no longer limited to a niche segment of teenagers and children; games today can be seen in multiple settings being used by a multitude of different audiences. Accessibility to the gaming space is no longer a luxury, it is a necessary component of creating an inclusive digital ecosystem. Gaming today is part and parcel of what is referred to as digital content, and, as such, is enshrined in the United Nations Convention on the Rights of Persons with Disabilities.

One of the main obstacles facing the accessibility of gaming is the general absence of legislation in this area. Unlike access to information and media, there is no explicit legislation outlining the need to making games accessible. Even in countries where there are laws that regulate video games, such as South Korea and the United Kingdom, there is no explicit mention of accessibility yet. The result is that initiatives to make games accessible are driven by conscious designers and developers, and not by national initiatives.

When it comes to people with functional limitations, there is an even further added element to gamification – and that is the use of games within a rehabilitation setting. In conjunction with international accessible gaming experts, Mada Assistive Technology Center initiated efforts to raise awareness about how gaming can be made more

inclusive for people with different disabilities. Amongst these efforts is providing training for game developers on how to develop accessible digital games based on best practices and international standards. Mada recently released a comprehensive best practice guide around this subject, which has been published on Mada website. The documentation is intended to be used by game developers, decision-makers, and frontline workers in different settings where they can effectively use gaming as an appropriate tool for social integration and even education or rehabilitation.

Mada has supported the localization and successful endorsement of an accessible gaming solution known as Wonder Tree in 2020. “Wonder Tree Games” is an augmented reality gamification solution which engages children with special needs for their therapeutic and cognitive development using the concept of mirror therapy. Using a Kinect sensor, a PC, and a TV screen, Wonder Tree use gamification to inject joy into physical and cognitive therapy for kids through fun, interactive, augmented reality games which are very affordable, easily accessible, and scalable globally. Wonder Tree solution is aligned to the UN Sustainable Development Goals and our contribution to UN-SDGs directly aligns with Reduced Inequalities.

In the times of Covid-19, Mada & Wonder Tree worked together to improve the accessibility of the platform to decrease dependability on physical solutions and increase digital methods for therapy and education needs.

Despite all the compelling reasons to ensure that gaming must be accessible to people with disabilities, gaming companies are not yet persuaded that there is a large market for accessible gaming – in both device controllers and game design. As such, funding and direct intervention by policymakers and service providers is required to stimulate the gaming market and make gaming more accessible to people with disabilities. Mada International Best Practices Guide on Accessible Gaming acts as a basic and introductory resource to policymakers, designers, developers, rehabilitation experts, educators AT specialists and end-users on how to create a more accessible gaming ecosystem in Qatar.

Making Social Media Accessible for All – YouTube

Oumer Seid
Mada Center

Social media refers to all applications and websites that are used to communicate and exchange information and media with other users through computers or mobile phones, and it also refers to any digital tool that allows users to create and share content on a large scale.

This article showcases some of the ways YouTube has been designed to be accessible to people with disabilities, thereby enabling everyone to share and access content in a manner that makes the most sense to them. The article is part of a Nafath series that focuses on the different ways social media platforms implement the fundamentals of accessibility and universal design to their websites and apps. At a time when the use of these platforms has become so common, taking the place of traditional media outlets and even workplace collaboration tools, it is important to ensure that there are ample resources out there to enable persons with disabilities to access them and use them equally.

About YouTube

YouTube was founded in February 2005 and it was acquired by Google for US\$1.65 billion in November 2006, and it is now one of Google's subsidiaries. YouTube gives users the options of uploading, streaming, ranking, sharing, playing lists, reporting, commenting on videos and subscription to other users. It has a wide range of user-generated and corporate media videos.

The content available includes video clips, TV show clips, music videos, short and documentary films, audio recordings, movie trailers, live streams, and other content such as video blogging, short original videos, and tutorials. Every month, more than 2 billion logged-in users visit YouTube, and people stream over a billion hours of content per day with billions of views.

There were more than 400 hours of content posted to YouTube every minute as of February 2017, and one billion hours of content viewed on YouTube every day. According to Alexa Internet, YouTube is the second-most popular website in the world as of October 2020, behind Google. As of May 2019, more than 500 hours of video materials are posted every minute to YouTube.

YouTube Accessibility

Videos should be delivered in an accessible format that ensure inclusion for all. An accessible video includes captions, sign language, and audio description, and is delivered in an accessible media player that is screen reader friendly.

A great majority of the online population is made up of PWDs. In view of this fact, content producers have sufficient justification to make all content on their YouTube channels accessible. Despite this, many YouTubers do not take sufficient steps to make their platforms accessible, despite the moral, economic and legal reasons for considering accessibility when building an online brand. Whether it's due to lack of information or funding, only a small number of YouTubers consider making their videos accessible. Anything published on YouTube must be accessible for all. When deciding how a video should be accessible, the content creator must think about:

- **Adding Closed Captions**

Closed Captions allow creators to share their videos with a wider public. Adding closed captions on YouTube can be done through uploading a closed caption file, by typing them in as they watch the video. YouTube can also use speech recognition technology to automatically create captions. If automatic captions are available, they'll automatically be published on the video, and the creator can then edit and correct the captions when needed.

How to Create closed captions?

- Sign into YouTube Studio.
 - From the left menu, select Subtitles.
 - Click the video that you'd like to edit.
 - Click ADD LANGUAGE and select your language.
 - Under subtitles, click ADD.
- **Including Sign Language.**

YouTubers can increase their videos' reach and accessibility by including sign language. Sign language is often unnecessary when closed captioning is available but considering there are hard of hearing users who cannot read, sign language is a way to go above and beyond.

- **Including Audio Description**

Audio description is a separate narrative audio track that describes important visual content, making it accessible to people who are unable to see the video. Individuals who are blind can understand much of a video's content by listening to its audio. However, if a video includes content that is only presented visually (e.g., on-screen text or key actions that are not obvious from the audio) this visual information must be described in order to be accessible to people who are unable to see it.

Making the Internet accessible takes time, knowledge, and skill. Even so, it can be surprisingly easy to contribute to accessibility with little changes that will benefit both creators and viewers. To make videos accessible content creators should consider adding closed captions, sign language translation, and audio description to their content.

Smart Apps for PWDs using TTS

Shahbaz Ahmed
Mada Center

Smart Apps for PWDs using TTS

Text-to-speech systems, also known as TTS, were first developed to aid the visually impaired by offering a computer-generated spoken voice that would “read” texts to the user. TTS software in general is considered an assistive technology tool that can be used in many ways.

Over the years, TTS has evolved with devices coming with built-in TTS feature and smart applications. There are many apps available, but typically as text appears on the screen, it is spoken by the app. Some software use computer-generated voices and others use a recorded human voice. Very often the user has a choice of gender and accent as well. Tablets and smartphones usually have built-in text-to-speech features. The software reads text files, the names of programs or folders when pointed at on the screen, and can read certain web pages aloud.

Built-in TTS in Smart Devices:

Most mobile devices come with assistive technology (AT) that can help with reading, writing and organization. Common built-in AT features include text-to-speech and dictation technology. However, built-in assistive technology features vary among mobile brands.

iOS has two text-to-speech (TTS) options that are useful for persons with disability. “Speak Selection” lets users select blocks of text to be read aloud. The other option is “Speak Screen” that reads entire pages of text. For both TTS options, users can choose to have the words highlighted as they are spoken. This feature helps the user to follow along. The voice and reading speed for the TTS can also be changed. If a word is not read correctly, the way it is said can be adjusted using the “Pronunciations” feature. For writing issues, iOS have the first built-in Dictation (speech-to-text) feature that can be activated by pressing the microphone button on the bottom-left of the onscreen

keyboard. This feature lets users write with their voices instead of typing. There's also a built-in word prediction feature called "Quick Type" in the onscreen keyboard. As users type, it suggests words for them to use in their writing.

Google Assistant on Android devices that have been licensed with GMS (Google Mobile Services) can use text-to-speech. Google Assistant allows the web browser to automatically scroll through a webpage and read what's written. As Google Assistant scrolls through a page, words will be highlighted as they are read aloud. Users can choose from a variety of voices with which their chosen bit of text is read.

Smart TTS Applications/software:

- **NaturalTTS**

Naturaltts.com software is a great option for consumers and enterprises that are looking for the best text to mp3 software. Featuring over 61 natural voices, this software is also offered in the most popular business languages, including Arabic, English, German, Spanish, and Portuguese. Customers can choose between male or female voices as well, depending on their objectives. NaturalTTS offers a free and paid subscription model for its services, boasting the lowest monthly subscription rates amongst its competitors. Furthermore, the website offers the chance to "try out" the software for free.

- **TTSReader**

NaturalTTS is an online text to speech software program that offers unique advantages. For instance, other platforms can restrict the total characters available for text to speech, whereas NaturalTTS asserts that its software can convert "whatever your browser can handle in terms of memory." The strong advantage is that this software program offers is its language functionality, as a drop-down menu enables users to select from a wide variety of languages, including several from Asia, Africa, and the Middle East. Furthermore, users can choose the speed at which the language is spoken. TTSReader would be especially appealing to those seeking high functionality.

- **Dragon Natural Readers**

Dragon Natural Readers is a free online text to speech software. It offers unique

benefits: instead of simply copying and pasting text into a text box on the website, it is possible to simply drag a file (.docx, .pptx, .pdf,) and other popular types into the website. Thus, consumers can “skip the step” of copying and pasting, saving incremental periods of time that collectively add up to significant time savings. However, consumers can still copy and paste the text directly online as well. Offering free and paid models, this platform is a good choice for busy end-users and those seeking quality TTS software.

In essence, the ongoing development of TTS software is just the tip of an explosive iceberg, as advancements in TTS correlate with advancements in artificial intelligence and machine learning. With time, the best text to voice software may eventually surpass the quality of audible information produced by humans.

Mada FabLab: 3D Printing and 3D Scanning for Assistive Technology

Achraf Ben Jamaa
Mada Center

Mada works with its various partners and innovators to develop an ecosystem that is supportive of innovating technological solutions that promote digital access for PWDs and the elderly. In this context, Mada FabLab has launched an innovation space designed to be fully inclusive for people with disabilities and empower them by providing more access to digital fabrication technology and support services that enable entrepreneurs, researchers, and startups to develop the assistive technology field.

The development of Assistive technology services is essential to make assistive devices more accessible to individuals with disabilities. Today, the use of 3D Printing is an affordable method to design and manufacture customized assistive technology to provide a better quality of life to people with disabilities. Generally, 3D Printers are becoming more accessible and more common within workplaces, homes, public libraries, and museums. Additive manufacturing is increasingly taking innovative approaches to create new assistive devices with new design like wheelchairs.

What is 3D Printing?

It is also referred as Additive manufacturing or Digital fabrication technology; it uses successive layers addition of materials to create a physical three-dimensional object from a digital geometric representation. In other words, the 3D Printer fabricates objects by depositing layer by layer material directly from a Computer Aided Design (CAD) file. Nowadays, additive manufacturing technology is widely used in a variety of fields all over the world. 3D Printing is a rapidly emerging technology as its been utilized in large industrial segments such as, automotive industry, customized production, aviation industries, agriculture, and healthcare sector.

How is 3D Printing making a huge impact in developing the assistive technology

services?

Recently 3D printers made prosthetics and assistive devices more accessible than ever, the technology became affordable with a reasonable price and high quality of printing. Even people who do not have access to 3D Printing they have been able to use inexpensive 3D printed assistive device and prosthetics provided by companies and individuals. One such example is a project that was launched by a US-company called “NOT Impossible Labs” that provided 3D printed prosthetics arms for amputees in war-torn Sudan. In fact, the company released the technology of the 3D printed arms for free and made it open source, in the hope that it will inspire other projects and help more than 50,000 people who have lost limbs due to conflicts.

Many other organizations have focused their attention on how to make assistive technology more accessible to people with disabilities. Fab Labs have succeeded in creating more accessible and participatory communities sprung up around 3D printed assistive device. There are approximately over 1500 Fab Labs all over the world providing access to 3D Printers, low-cost material and open-source designs that helped promote innovation in assistive technology.

Today, 3D printers use a variety of material which has allowed manufacturers to produce reliable lightweight devices. These devices are easily customized based tailored to the user needs and comfort with only using a CAD open source platform. The adoption of 3D printing has made the availability of prosthetics and assistive device extremely easy and fast, which reduces the recovery time and give a better quality of life for the disabled individuals. One such example, a 3D printed assistive device that helps people with arthritis to reduce dexterity. This tool takes almost an hour to be printed and it can be attached to the home key to help reduce the grip strength needed to unlock doors. Additionally, there are more simple 3D printed designs that can help people with limited control of their hands, like Pen holders, Cup holders and spoon supporters.

In conclusion, no one can deny that the benefits of 3D Printing in the field of assistive technology are almost limitless, and every day we are witnessing more developments in the additive technology field which will have a positive impact on PWDs inclusion.

The launch of Mada Fab Lab came as a result of the center's commitment to promote innovation and achieve full inclusion of PwDs and the elderly in their communities by adopting and supporting the use of latest technological innovations in this field.

Emerging Innovations in 2021: What's next?

Anirban Lahiri
Mada Center

▪ **Quantum Computing (1)**

Quantum computing could eventually transform medicine, break formerly reliable encryption, and revolutionize communications and artificial intelligence. While the Fourth Industrial Revolution has been built on technologies at a molecular level by integrating the physical, biological, and digital worlds, the advent of quantum computing means that the fifth wave of technology may largely take place at an atomic scale. However, despite recent advances, only a handful of quantum algorithms exist – and it remains an open question whether quantum computers will truly outshine their classical peers.

▪ **Advanced Materials (2)**

From the Stone Age to the Bronze Age, and to the Iron Age, every major advancement for human civilization has been driven by development in materials. In today's Silicon Age, semiconducting materials underpin the microelectronic devices and information technologies that enable much of modern living. Now, new materials are needed – to improve our collective quality of life, and to ensure greater environmental sustainability for the planet. Materials science and engineering research are constantly moving forward to help address these goals.

- Advanced Materials for big data.
- Ink-jet printed graphene.
- Fluorescent Carbon-Based Nanostructures for Bioimaging Applications.

▪ **Internet of Things (IoT) (3)**

The Internet of Things, or "IoT," surrounds us with networks of smart, web-connected

devices and services capable of sensing, interconnecting, inferring, and acting. It is enabling the development of new products and business models while creating ways for governments to deliver more useful services and better engage with the public. Some of the most important issues related to IoT include technology architecture and standardization, safety and security risks, threats to privacy and trust, potentially missed opportunities for broad social benefits – and a need for responsible governance.

- **Bio Big Data and Biotechnology (4)**

The automated analysis of increasingly large sets of genetic data promises to transform health care. Biomedical science is transforming into big-data science. Currently, archived datasets represent only a small fraction of the genome-related big data yet to be produced, as sequencing capacity will continue to grow.

- **Data Science & Machine Learning (5)**

The era of data is upon us. It is proliferating at an unprecedented pace, reflecting every aspect of our lives and circulating from satellites in space through the phones in our pockets. The data revolution creates endless opportunities to confront the grand challenges of the 21st century. Yet, as the scale and scope of data grow, so must our ability to analyze and contextualize it.

Large-scale machine learning systems need to be integrated with vast computing infrastructure for deep learning, one of the most promising branches of artificial intelligence, to help better enable the navigation of big data and detect things that are impossible to catch manually. Machine learning could facilitate the mining of gene-to-gene interaction, the classification of cellular images, and finding links between datasets.

- **Behavioral Sciences (6)**

behavioral sciences are a powerful tool that can be wielded to engender responsible decision-making and improve the quality of life. Behavioral sciences have a significant role to play in smoothing society's path amid the dramatic changes accompanying the Fourth Industrial Revolution.

- **Blockchain (7)**

Blockchain can enable greater trust and transparency through decentralization, cryptography, and the creation of new incentives. The financial sector is investigating blockchain as a means to replace expensive and inefficient payment systems. It could also reshape supply chains – particularly in combination with the Internet of Things and artificial intelligence – while boosting the practical, day-to-day use of smart contracts, digital currencies, and digital identities.

- **5G (8)**

5G is next-generation wireless network technology that's expected to change the way people live and work. It will be faster and able to handle more connected devices than the existing 4G LTE network, improvements that will enable a wave of new kinds of tech products.

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Mada and Lazarillo facilitate the access of people visually impaired to the Mathaf Arab Museum of modern Art

Al-Dana Ahmed Al-Mohannadi, Shahbaz Ahmed
Mada Center

Museums can be hostile place for visitors with disability, with buildings that are hard to navigate in a wheelchair, and exhibits presented with few concessions to those with sensory or cognitive impairments. With the right solutions, expert recommendation and user feedbacks, accessibility can be improved to meet the growing need for accessible tourism spots in Qatar.

Out of its commitment to perform its role as ICT Accessibility strategic enabler, and in line with its efforts to enable equal basis for PwDs and the elderly to take part in cultural life via ICT, Mada is developing an innovative project together with the Mathaf Arab Museum of Modern Art in Qatar and Lazarillo. The initiative seeks to allow visually impaired people to visit the Mathaf facilities, using an internal navigation system that is currently in the pilot phase.

Such an initiative is about making art more accessible for everyone, the Lazarillo audible guide and map will help users experience a tour and find their way around the museum. Lazarillo with its free mobile app helps persons with disabilities navigate the physical and digital world of companies and public institutions services, reducing anxiety and saving time to customers with an audible assistance that expertly guides them through their physical space and connects them to services while being at home. Companies Improve the experience of their customers with disabilities in an easy, simple, and secure way.

With such a collaboration, Mada aims to enhance the user experience as visitors are guided through the various exhibits in a way that maximizes the learning experience. This makes museums more efficient, and the experience of the visitor more enjoyable.

Lazarillo is a tool used every day by persons with disabilities to help them navigate their world. It can be also used as a communication platform by uploading content and services to further inform customers about various services and benefits. Lazarillo is

designed for persons with disabilities who use smartphones on Android or IOS systems. It is accessible for people that are visually impaired who use “Talkback” and “Voiceover” screen readers. Persons with visual impairments receive audible directions with information to guide them through their surroundings. For persons with physical disability, it provides information on accessible routes, showing the best way to maneuver without problems.

Today Lazarillo has grown to 180,000 users globally in 45 countries and it is available in 25 languages including Arabic. It has digitized locations of companies and made them accessible including banks, hospitals, University campuses, museums, retail stores, parks, and public buildings. It also launched a newsfeed to promote information in accessible ways which is currently used by several government agencies and companies. [Lazarillo was a winner of Mada – Seedstars ICT Accessibility Award 2020, and if you would like to know more about Lazarillo and this great project go to <https://www.lazarillo.app> and download the app].

How it will work in MATHAF?

Lazarillo will digitize Lazarillo floor maps, detailing places of interest (services), which allows users to create direct routes to their specific desired service. The app will create a narrative for the exhibition gallery allowing users 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. The devices do not need updates, electronic connections, or internet connection. When someone with the Lazarillo App enters the venue, the beacons send an identifier that the app detects. Lazarillo’s wayfinding platform will be applied in the MATHAF. The customized solution will be useful for persons with visual impairments who can use the app to guide them using audio messages to find the point of interest and services inside the venues. For persons with physical disabilities, the app can guide them by showing accessible routes within a venue. The interface is available in English and Spanish, and app is adaptable in 22 different languages including Arabic.

This pioneering initiative by Mada Center, in cooperation with Lazarillo and the Arab Museum of Modern Art, will positively reflect on the accessibility of people with visual impairments to the museum, its exhibits and activities. This will promote their inclusion and ensure their greater participation in cultural and entertainment life

The Unified Arabic Braille Portal by Mada

Mada Center

Mada Assistive Technology Center pays special attention to research and publications in the field of ICTs accessibility, as the center strives to promote leading industry practices at the global, regional and local levels.

Mada aims to conduct various researches to analyze the reality of digital access and develop solutions for ICT accessibility in the Arab region in accordance with the latest trends and international best practices. In this context, the Center launched the Unified Arabic Braille Project and the first electronic portal specialized in the Unified Arabic Braille Language.

Braille is a method of reading and writing that relies on touching prominent dots that people with visual disabilities recognize 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. Braille helped blind children learn to read and write, and adults who lost their ability to read, due to blindness or vision impairment, continued to enjoy access to books, magazines, and other knowledge resources. Braille characters are written through bands called braille cells so that each cell mostly forms one character. Depending on the shape of these dots within the cell, each character is different. The maximum number of dots per cell is six dots, and the minimum number is one dot. Each cell is a small rectangle with two columns and six dots.

Braille is the only and unique method that enables blind or deaf-blind people who have difficulties accessing printed materials to read and write. In fact, the ability to write and read in braille opens the door to knowledge, intellectual freedom, equal opportunity and personal security. Nowadays, the cost of Braille electronic devices has begun to decrease significantly, which means that a larger segment of the blind – especially in developing countries – can access Braille electronic devices, but still there is not enough content to support the Arabic Braille. The ambition of every person who is a beginner at using braille is to have digital resources that he can use to identify the dots of letters and symbols shaped on these letters. Thus, providing Arabic Braille digital resources is an important addition for those wishing to learn braille including parents and academics, and those wishing to stay up-to-date with Arabic Braille.

The aim of the Unified Arabic Braille Portal by Mada, is to promote and develop the Arabic Braille. Mada started the project after conducting a survey about the use of Braille system in the Arab world. The survey results confirmed that the blind complain about three important things:

- Significant shortage of digital educational resources for the Arabic Braille system.
- The current Braille system has many issues and shortcomings.
- There are several problems with the software while writing and reading in Arabic Braille.

Mada developed a web-portal containing 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.

The six-dots Braille systems allow encoding of a maximum of 63 characters, which is sufficient to encode letters, numbers, punctuation marks, and some signs of the approved Braille system. However, these systems do not provide enough coding capacity for coding symbols used in science such as mathematics, physics, chemistry or even music. Hence the importance of the eight-dots coding system, which enables coding up to 255 symbols. This gives sufficient scope for the inclusion of all the important symbols. Using this system allows people with visual disabilities to read and write scientific, literary and artistic contents. Adopting a Unified Arabic Braille coding system has become important to allow Arabic blinds to create and read Arabic content. In this context, Mada developed the first 8-dot Arabic Braille computer table to support Braille abbreviations in the fields of mathematics and science. The 8-dots computer Braille table is a tremendous addition that will assist users of Braille displays and speaking computer programs in a smoother use of braille.

The Unified Arabic Braille Project 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. Liblouis software library is a free and open-source tool, that provides converting, reverse converting, and braille formats for many languages, and it consists of a group of packages designed for use in many applications and devices, whether

free or commercial. This package was written in C programming language so that it does not require a specific environment, and thus, can be easily used within applications written in high-level languages such as Java and Python. The Arabic Braille table was created from scratch and included in the Liblouis Software Library. It relies on writing Arabic language and displaying it in the system of abbreviations. All Arabic abbreviations that were approved in the Arab Braille Conference in Riyadh in 2002 were also included.