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Toward a Full Integration of the Arabic Language into 'Intel ACAT' Assistive Platform

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Nadji Ahmed Zakariya[1], Boudour Rachid[1], Abdourazek Souahi[2]
1.Embedded Systems Laboratory - ESLA, University of Badji Mokhtar Annaba, Algeria
2.Laboratory of Advanced Materials, University of Badji Mokhtar-Annaba, Algeria

Abstract

Background:
Assisting people with severe physical limitations with information technology has been an active area of research in recent years. Many researchers' efforts are built on assistive devices which are often used to offset the impact of the resulted physical impairments.
The Assistive Context-Aware Toolkit (ACAT) is the widely known project in this area. After being released as open source, the developers' community helped to integrate many languages such as French and Spanich. However, many languages are still messing and to the best of our knowledge, the Arabic-speaking users still can not use the platform as no significant effort to integrate the Arabic language have been previously undertaken.
Methods:
This paper firstly, provides an overview on ACAT; the specifically-developed platform by Intel Labs for Dr. Stephen Hawking. Besides, it describes the ways in which ACAT may be used to enhance the capacity to take part in fundamental and instrumental activities of every day living and upgrade one's autonomy in general.
Secondly, we outline our contributions in integrating the Arabic language into the keyboard, the intelligent predictive text engine and all interfaces of this unique and highly configurable system.
Results:
Our integration evolved after resolving many issues and we succeeded in integrating the Arabic language in interfaces, keyboard and word prediction engine. Most of other ACAT features (Facial gesture recognition, Mouse Navigation., etc) are functional.
Conclusion:
This work is a step forward to make the intel ACAT platform completely available in Arabic language. Therefore, Arabic-speaking patients can now get the benefits from this platform and are able to perform common tasks such as documents editing and management, Web surfing, writing emails and above all, communicating with others easily. The Arabic Text-to-speech engine integration is planned for future works .
Keywords: Intel ACAT, Assistive Technology, Arabic language

Corresponding author: Nadji Ahmed Zakariya University of Badji Mokhtar Annaba, Algeria, Nadji.zakaria@gmail.com
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1. Introduction

The steadily increase in the number of persons with disability worldwide is worrying , the total number of people with one or more forms of disability, estimated by the World Health Organization is about 1 billion [1], with up to 190 million having significant difficulties in functioning. In Algeria, where the current population is about 42 million [2], the number of persons living with impairment is about two million according to the Office of the High Commissioner for Human Rights of the United Nations [3].
In today's dynamic world, life without technology is worthless, for the physically challenged persons, Assistive Technology (AT) is used to enable and enhance their inclusion and participation in everyday activities and its use has become prevalent to overcome the environmental and attitudinal barriers they face[4].
Like their counterparts who are physically fit, Algerians with physical disabilities typically experience a lot of impairments, including but not limited to social

communication, in their behaviors; these impairments leads to poor adaptive skills, including personal living, and community living skills [5].
Since the definition of AT is "any item, piece of equipment or product that is applied to secure, increase, maintain or improve functional capabilities" [6], ATs are often experienced as an extension of the body since they are used to improve, expand or extend people's performances, actions and interactions.[7]
As mentioned by Lancioni in his work [8]: "The AT and technology-aided program required to help these individuals might involve (a) a sensor that the individuals can activate with a small response (e.g., a finger, lip, small head, or eyelid movement) and (b) a computer or other electronic device that responds to micro switch activations by delivering specific stimulation. The use of this technology aided program can provide the individuals with the necessary support to make their small responses functional to access and control preferred environmental stimulation".
In the same context, in 2015, Intel has released for free, a highly configurable open-source assistive platform called Assistive Context-Aware Toolkit (ACAT), to help people with such physical conditions to have full access to the capabilities and applications of their computers through very constrained interfaces suitable for their conditions [9,10], but there's one downside , the ACAT can be used only in few languages (English, Spanish, Portuguese and French).[11].
Through a review of the existing literature on ACAT and after testing the platform we intend in the first part of this work, to outline its applications and how it may be used to increase independence, improve personal productivity, enhance the quality of patient's life, and identify current barriers to its effective integration in the Algerian context with an accentuation on empowering Arabic-speaking patients to end up autonomous and gainful individuals from standard society. In the second part, we present the preliminary contribution of the authors, which consists of expanding the Intel ACAT platform and make it useable for Arabic-speaking paralyzed people by integrating the Arabic language into the keyboard, the intelligent predictive text engine and all of its interfaces.

2. Motivation

Accessible and moderate AT access for all individuals has been cherished as a human right inside the United Nations Convention on the Rights of Persons with Disabilities [12], however significant unmet and under met need for AT exists [13]. The World Report on Disability appraises that just 1 out of 10 individuals approach AT: a shortage for more than 1 billion individuals [1].
Thus, in Algeria like elsewhere, individuals with handicaps, might be not able to have any contact with their direct environment. Setting up such contact and creating essential types of control of favored natural incitement would rely upon the possibility of using their minimal response repertoire [8,14].

3. Overview on Intel ACAT

The huge quantity of assistive products and related services is increasing exponentially as a result of technological developments. The challenge is not only to inform people about their existence, yet in addition about their quality, convenience, adequacy and availability. Moreover, it ideally should be unbiased/autonomous (not impacted by business or different interests) and bolstered by research proof and depends on client encounters and needs [15].

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Based on the above mentioned criteria, and according to [9] and [10], we found that ACAT is the most suitable Assistive device for Algerian disabled people with low or no income.

In fact, ACAT is an open source platform developed by researchers at Intel Labs to help Professor Hawking, who had amyotrophic lateral sclerosis (ALS) communicate by translating his facial movements into text. ACAT is organized as a modular system; the ACAT Core library and the ACAT Extension library give all of the ACAT's core functionalities, such as text-to-speech module, word prediction and input switch trigger handling. Applications interaction with extensions is over well-defined interfaces. Extensions raise events to notify subscribers when something interesting happens [11]. The ACAT Resource library handles localization of ACAT in different languages. See Figure 1.

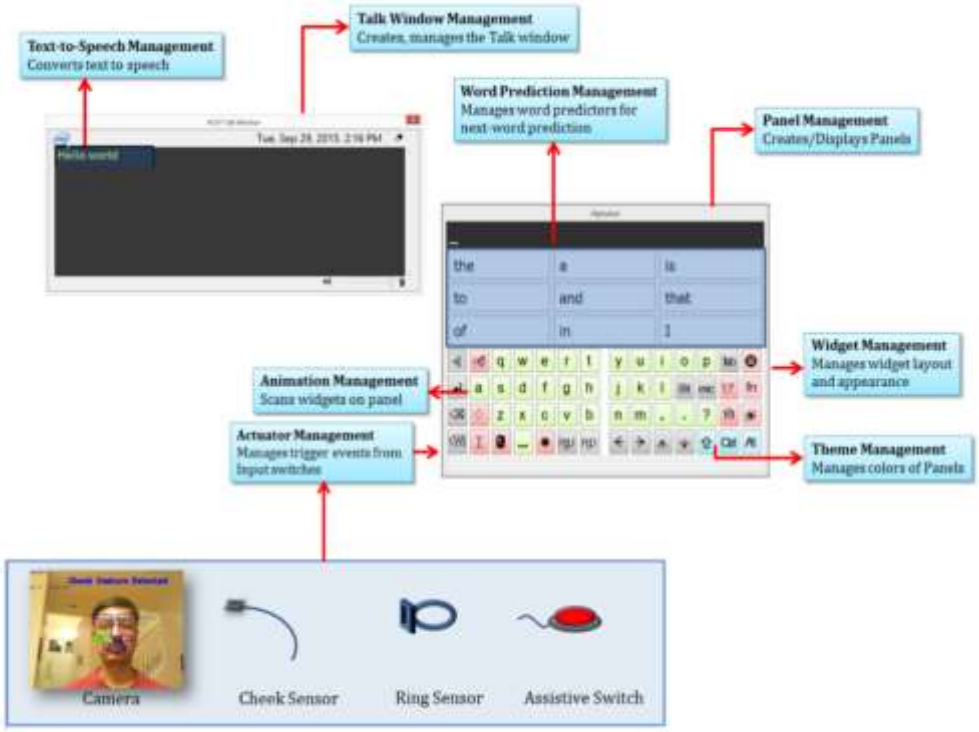

Figure 1: ACAT core components

By sharing this platform with the public, Intel hopes developers will expand its application to a wider range of disabilities by adding new sensing modalities, new user interfaces (UI), word prediction and many other features to assist in communicating via text or software command[11] , More details on ACAT and its principal components can be found in [10], [11].

In Algeria, the Intel assistive platform ACAT can be used in foreign languages only, mainly in French or English. The Arabic-speaking users, who represent the majority of the patients, still unfortunately cannot use the platform.

The system works as intended and seems very promising for the Algerian Context as it was for other countries where tested before.

4. Integration of the Arabic language

As detailed in the previous section, the ACAT platform is helpful for researchers and engeeiners who are keen on creating assistive advances to individuals with inabilities not with standing specialists who are taking a shot at new user

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interfaces, new detecting modalities or word prediction and needing to investigate these developments in the community [11].

The availability of the platform in only few languages proves limited for Algerian users. Thus, in order to bridge this gap we took the initiative to make the platform available in Arabic. This part describes the different steps including (a) creating/integrating Menus, Keyboard, all interfaces (b) configuring Scanning (The process of selecting by highlighting), then (c) creating the database of prediction engine.

Interfaces and menus

In the first place, we created Arabic Interfaces and Menus; we followed the ACAT developer's guideline [16]. The code is entirely written in C#, using Visual 2012 and Microsoft .NET Framework 4.5. Then we had to create an Arabic library of all words and strings used in interfaces, dialogs and menus (about 400 words), the library is named ACATResources.ar.resx, see Figure 2.

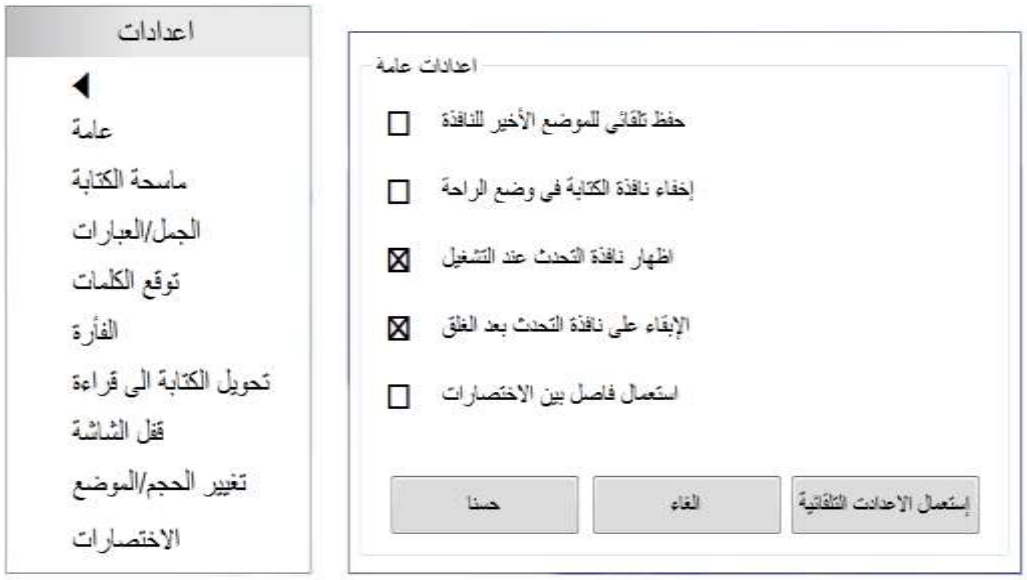

Figure 2: Example of Settings menu and General settings dialog in Arabic

Keyboard

Thereafter, we integrated the Arabic into the visual keyboard. It's worth mentioning that the Arabic alphabet contains more letters than the English one but in Arabic there are no capital letters. Thus, several methods can be used to implement the alphabet in ACAT. One can add rows or columns, or just add some letters as capitals of others. We choose to add more buttons instead of using the shift button, see Figure 3.

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Figure 3: Arabic Keyboard; 1st configuration

We had also to configure the Alphabet scanner for this new keyboard to enable the text entry. All other scanners (for cursor navigation, selecting, etc.) remain the same.

Word prediction

Presage, the intelligent predictive text engine created by Matteo Vescovi, drives ACAT 's Word Prediction module[17]. It provides prediction results based on the context for auto-completion or next-word. Prediction results are returned in the language that is currently active. The results are obtained by looking up a word prediction database that is created from source texts in that language. For more information see [18].

For the integration of the Arabic language for our case, an Arabic database was built using "text2ngram" tool [19].

5. Results

The integration of Arabic language (except Text-to-speech) into the ACAT platform was difficult but successful. It offered a new opportunity for arabic speacking users to get the benefit from Intel ACAT more conveniently. It can address their various needs, such as expanding socialization, independence and leisure options. They can now communicate, navigate the web and understand all the features offered by ACAT see Figure 4 and Figure 5.

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Figure 4: Testing Facial gesture recognition after the integration

Figure 5: Browsing the internet over Facial gesture recognition under ACAT

6. Discussion

The intelligent predictive text engine will improve the Arabic database by automatically learning new words based on the patient context.
For the keyboard part, as mentioned before, several methods of implementation are possible. We can add a dialog to permit the user to choose one of them as per individual preferences. Diacritics could also be added in the keyboard in Arabic. One diacritic can change the whole meaning of the sentence. We recognize the need of new research and efforts to provide the ACAT platform for other operating systems (ACAT runs only on Microsoft Windows).

7. Conclusions

After reporting the potentials offered by the Intel ACAT platform to enhance the personal autonomy and quality of life for people with acute disabilities, the

barriers to its implementation and adoption in the Algerian context were found to include primarily the unavailibility of the platform in the Arabic language.
In order to cross this barrier, we integrated partially the Arabic language into the ACAT platform and discussed some of the faced integration issues.
This integration would make a real difference for Arabic-speaking patients by helping these 'locked-in' individuals in daily tasks such as communicating with others, navigating the Intenet and access to information.
This work will also provide researchers with an arabic interface to create customized solutions as per patient needs and preferences in term of keyborad and word and sentence prediction with diacritics.
We plan to make the plateform fully suitable for Arabic-speaking patients in future works and we intend to customize it further for the Algerian population and test it intensively.

8. Conflict of interest statement

Authors declare no conflicts of interest.

9. Authors biography

No biography

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