e-AAC: Making Internet-based Interpersonal Communication and WWW Content Accessible for AAC Symbol Users

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Abstract

In this paper we present the dynamics of making both the internet-based interpersonal communication and the content of the World Wide Web (WWW) accessible by the language-impaired persons or Alternative and Augmentative Communication (AAC) users. To cope with this problem we introduce e-AAC, an infrastructure of multimedia concept representations for database-aware services and applications. We present the main features of e-AAC in terms of design and implementation characteristics, along with usage properties and applications.

1 Introduction

It is common practice, even in our everyday activities regarding interpersonal communication and presentation of information to take for granted that a natural language would be used in either written or oral form. However, language-impaired people rely heavily on the use of symbolic communication systems (such as Blissymbolics, PIC, PCS, MAKATON, Rebus, etc.) that use graphic symbols in order to depict concepts and convey meanings to their users (Fuller, Lloyd & Schlosser 1992). Computer-based AAC systems enable the formation of symbol based "sentences" that are then transformed into speech, mainly for face-to-face one-way communication. Recent research developments have shown that two-way communication between a symbol user and a user of a different symbolic system or a user of a natural language is possible either in real time through e-chatting or asynchronously by e-mailing usually through proprietary implementations (Hunnicutt & Magnuson, 2001, Viglas, Stamatis & Kouroupetroglou, 1998). However, a universal service supporting internet-based interpersonal communication between users of AAC symbols and the ones of a natural language is not available yet. Furthermore, when in comes to information presentation that is widely and openly offered by the WWW, language-impaired are more or less left out. The guidelines offered so far by the WWW Consortium-Web Accessibility Initiative (W3C-WAI, 1999) do not cover in depth the needs of symbol users on the aforementioned issue. However, it is realized that such users exhibit much diversity in terms of needs, skills and the communication system they use, and are also confronted by a lot of diversity and obstruction over the WWW (Vanderheiden, 1995). In this case comprehending the content, necessitates its transformation into a form that the AAC symbol user can understand and make use of (such as symbols, images, speech, sounds or even videos). In the light of the aforementioned, it becomes evident that whether the issue is communication or information presentation AAC users need to have the original content somehow transformed or transcribed in a meaningful and usable manner with the proper participation of a variety of representation media (after all, a language element may be associated with various concepts or symbols and media representations in a given

context). The solution we came up with in order to accommodate accessibility, was to develop the e-AAC infrastructure which enables internet-based interpersonal communication, as well as web page content and information presentation to be managed in a uniform manner and delivered to the AAC user according to the alternative communication system used.

2 The e-AAC infrastructure: Properties and Features

The e-AAC infrastructure aims to satisfy the diverse and evolving with time needs of AAC symbol users and keep up with the developments in software building technologies especially concerning internet-based communication, information exchange and web-enabled access (Kobryn, 2000), (XML, 1998). The various modes of communication (local, face-to-face, remote, real time, or asynchronous) are properly addressed even for low rate and bandwidth situations, in order to maintain effective communication. Different types of information representation to the conversation parties are also carefully considered in all possible combinations (on-demand use of multiple output modalities, such as speech, audio, visual, text/printed).

The key idea behind the infrastructure is to begin with a lexicon of well-defined, language-independent Interlingua concepts. Each concept may have different media representations (such as written or spoken from, onomatopoetic, picture, photo or video) in any natural language and any AAC symbolic system. Inclusion of additional linguistic information such as morphological, syntactical and semantic, helps to overcome mismatching vocabularies (Antona, Stefanidis & Kouroupetroglou, 1999). In this respect, the e-AAC infrastructure consists of a properly designed internet-accessible database (realized through a contemporary Database Management System) of multimedia elements that encodes Interlingua concepts and their mappings to natural languages and symbolic communication systems, and interconnects them with all possible media representations (text, picture, video, sound, speech, etc.). Effort was put in using a flexible internal encoding that easily relates to other standards or encodings to ensure compatibility with well-established systems (e.g. for an advanced symbolic system like Blissymbolics all the internationally accepted symbols are included in the database, taking into account the Unicode encoding proposal, for an ISO standard, 1998). The database is open and expandable in terms of concepts, natural languages, alternative communication systems, and potential corresponding properties allowing even for diverse user specific or tailored mixtures and definitions that overcome language, cultural, disability or otherwise barriers. It also includes structures that allow for multiple classifications per language and system, as well as the definition of vocabularies and selections sets per potential user or group. Additional internal structures act as meta-entities in order to allow further language-specific properties and linguistic data to be included as well. Database content expansion is realized by a specific, centrally supervised workflow that allows for suggestions to be made by well-established organizations and user groups alike.

We have also incorporated Machine Translation (MT) elements and techniques into e-AAC's interlingua protocol in order to ensure omni-directional, concept-by-concept transcription of content between elements and media representations of any language and system defined in the database, since the media diversity exhibited between the various languages and systems requires such a translation feature (Viglas & Kouroupetroglou, 2002). Moreover, the ability of our infrastructure to integrate linguistic extensions or interface with external modules for Natural Language Processing (NLP) provides the basis to ultimately reach an acceptable degree of content translation and presentation that is accessible and correct in terms of semantics, grammar and syntax.

Any transaction with the infrastructure can be summarized in the following steps (regardless whether it has to do with communication or web content, as it is depicted in Figure 1):

- A software application inputs a concept forming a transcription request.
- User group characteristics are considered alongside specific output requirements (in terms of languages, media, etc.).
- The incoming concept is recognized and then using the interlingua encoding protocol gets matched against the and the lexicon, leading ultimately to the best output concept in the desired form.
- Media and concept information is returned making the transcription possible (the transcription itself may take place as a server- or client-side process according to the application implementation).

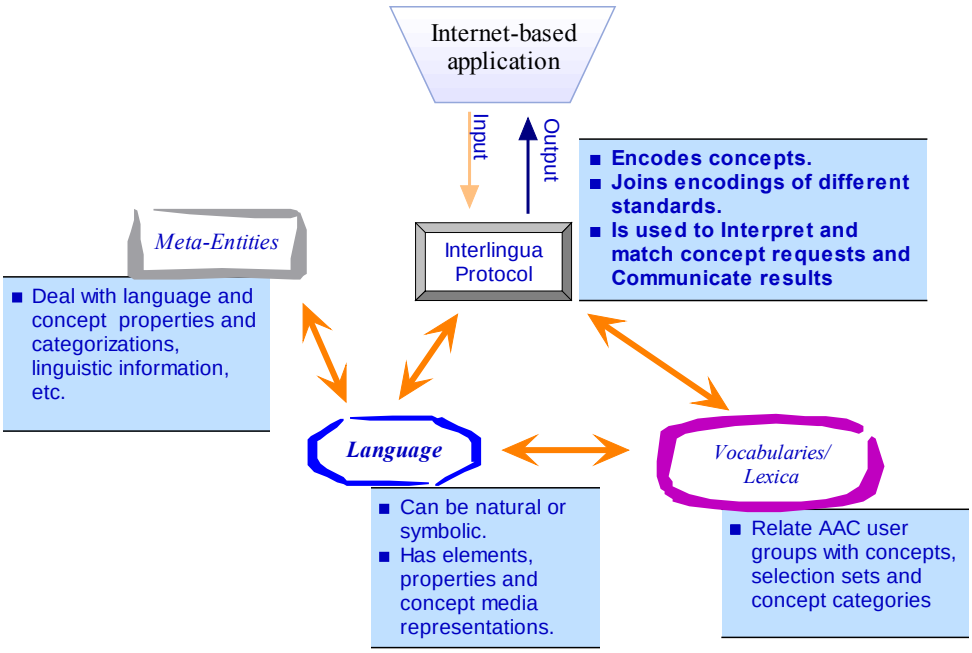

Figure 1: An abstract view of e-AAC

In this respect, any incoming concept, whether it belongs to a communication message or constitutes a content fragment in a web page can be properly transcribed for a specific user group, either locally or remotely (server-wise) by way of software applications adopting in principle the e-AAC paradigm (something that is graphically presented in Figure 2). Because of its open and scalable nature, the e-AAC infrastructure can be easily integrated and collaborate with modular software environments and accessibility-oriented web markups.

The e-AAC infrastructure exhibits scalability, reusability, expandability, openness, language and media independence, and low bandwidth support for all communication modes. This is ensured through a flexible internal storage or information in a text-only form with URL-like links to binary objects. Such a technique that allows transparent modification of the binary objects without affecting database content, as well as transparent transmission of concept codes when communication and translation is needed. The e-AAC database may co-exist in a number of instances according to location, languages, lexicon size, content and utilization,. A main instance

can be a central, server-like or reference database, bearing literally any available information on the structures and entities incorporated. When used as a module for communication applications, it can be transformed into a customizable subset of the original database according to specific user needs and requirements (concerning any adaptation or modification to concepts, natural languages and symbolic systems to be used, vocabulary and selection set definitions, gender specifics for user personalization, etc.), that is stored locally alongside the application that uses them.

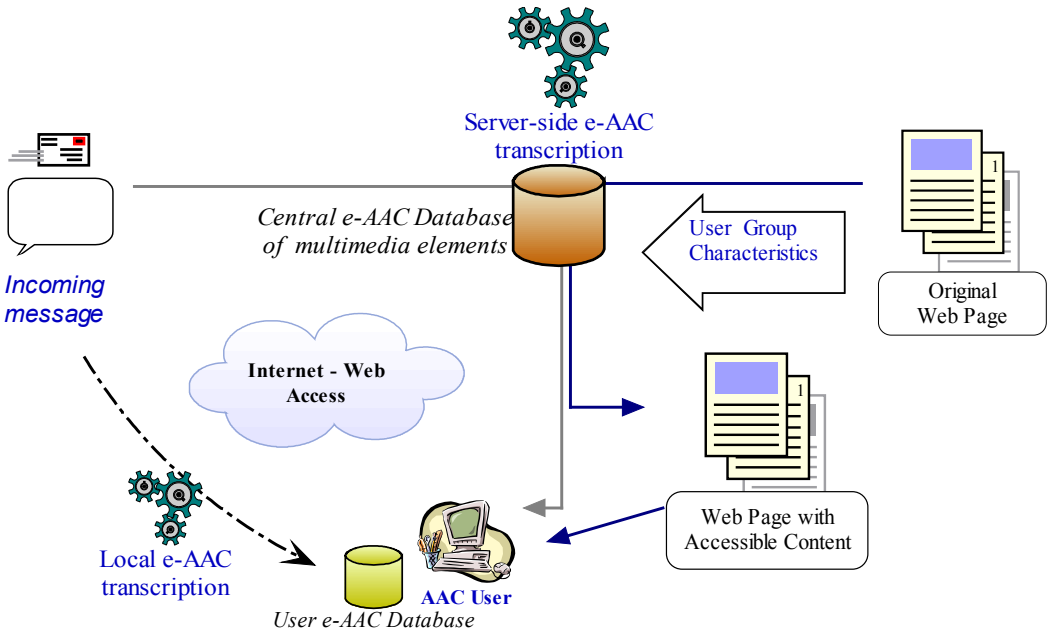

Figure 2: Local or server-side accessibility is possible for both communication messages and web content using the e-AAC infrastructure

3 e-AAC in action: usage and testing

Since the e-AAC database core can be made available over the internet, usage of the infrastructure is attainable by implementations that can be database-driven or at least incorporate access to a database object in their design, both in stand-alone cases and web-based ones that are by default internet-oriented. Once the e-AAC database schema is made known to developers, they may, in turn, easily take advantage of the information stored in the database to make their application content accessible by a variety of AAC user groups.

Field-testing of e-AAC was conducted by way of designating, implementing and using a number of software applications targeting language-impaired users under real-life situations. The tests used a reference e-AAC database with 2064 defined concepts in 4 languages (English, Greek, French, Spanish) and 4 systems (BLISS, MAKATON, PCS, ASL) rendering the infrastructure beneficial to AAC users, and confirmed its properties. These applications include a web-based translation dictionary between the concepts, symbols and media representations of various languages and communication systems, a web-based symbolic system tutoring application, a

vocabulary management component as well as e-mail and e-chat clients for modular internet-based communication aids (Kouroupetroglou & Pino, 2002).

4 Conclusions

We have presented a flexible and viable solution to the issue of making internet-based communication and web page content accessible by AAC through the e-AAC infrastructure. We provided information on the infrastructure's implementation and features, and described its internet-enabled core, which takes the form of an open and scalable database of multimedia and linguistic elements. Field-testing results of implementations under real-life situations were also given, adding further to the value to e-AAC's potential for successful communication and content accessibility for AAC users. Future plans include further enhancements in terms of linguistic and transcription features and capabilities, as well as becoming the cornerstone for a proposal for standardization for content and communication accessibility purposes.

5 References

Antona, M., Stefanidis, C. and Kouroupetroglou, G. (1999). Access to Lexical Knowledge in Modular Interpersonal Communication Aids. Augmentative and Alternative Communication, **15**, 269-279.

Blissymbolics Unicode encoding proposal. (1998). Available at http://www.dkuug.dk/jtc1/sc2/wg2/docs/n1866.pdf

Extensible markup language (XML) 1.0. W3C Recommendation, 1998. Available at http://wwww.w3.org/TR/REC-xml.

Fuller, D., Lloyd, L. and Schlosser, R. (1992). Further development of an augmentative and alternative communication symbol taxonomy. Augmentative and Alternative Communication, **8**, 67-84.

Hunnicutt, S. & Magnuson, T. (2001). "Linguistic structures for email and echat." In: Karlsson, A. & van de Weijer, J., eds., Working Papers 49. 2001: Papers from Fonetik 2001, Lund University Department of Linguistics, May 30-June 1, 2001, Örenäs, Sweden; 66-69.

Kobryn, C. (*2000).* Modeling Components and Frameworks with UML. *Communications of ACM, 43(10)*, 31-38.

Kouroupetroglou, G. and Pino, A. (2002). A New Generation of Communication Aids based on ULYSSES Component-Based Framework. Proc. of the 5th Int. ACM Conf. on Assistive Technologies, ASSETS 2002, July 8 - 10, Edinburgh, Scotland.

Vanderheiden, G.C. & Kaine-Krolak, M. (1995). Access to current and next-generation information systems by people with disabilities. Trace Research & Development Center, University of Wisconsin-Madison, Madison, WI. Available at http://www.trace.wisc.edu/ docs/access_info_sys/full_doc.htm.

Viglas, C., and Kouroupetroglou, G. (2002). "An Open Machine Translation System for Augmentative and Alternative Communication", Lecture Notes in Computer Science (LNCS), Vol. 2398, 2002, pp 698-706.

Viglas, C., Stamatis, C. & Kouroupetroglou, G. (1998). Remote Assistive Interpersonal Communication Exploiting Component Based Development. Proc. of ICCHP'98, 31 August - 4 Sept. 1998, Vienna – Budapest, 487-496.

W3C-WAI. Web Content Accessibility Guidelines 1.0. W3C Recommendation, 1999. Available at http://www.w3.org/TR/WCAG10/