Information and Communication Technology Services for Augmentative and Alternative Communication: a Croatian Perspective

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A certain level of communication skills plays an important role in life. However, people with various disabilities may require aid in satisfying their complex communication needs. This paper briefly details legislative and technical background for supporting augmentative and alternative communication services for Croatia's residents with disabilities. Regarding the inclusion policies enacted in Croatia in the last half of a decade, we claim the significant future need for systems and mobile services for augmentative and alternative communication based on information and communication technology. In order to make such services usable and useful for disabled people, it is inevitable to make efforts in multidisciplinary research and development, and build affordable and mobile solutions which input and output functionalities satisfy both independent and assisted living programs for people with disabilities.

Augmentative and alternative communication (AAC). HCI. Primary healthcare. Appropriate technology. ICT.

1. INTRODUCTION

Communication is essential for active participation in everyday life, from work engagement to personal settings. Nevertheless, some people may not have the communication skills to meet all of their needs. Their complex communication needs (CCNs) may be associated with developmental (e.g. cerebral palsy, Down syndrome) or acquired disabilities (e.g. stroke, multiple sclerosis). Due to the significant impairments, these persons cannot longer communicate in a conventional manner. In order to cope with and support CCNs, the area of clinical practice called augmentative and alternative communication (AAC) has been established to improve effectiveness of communication by using symbols, aids, techniques and strategies [Justice, 2010]. AAC includes systems, both technical and non-technical, that augment speech by using facial expressions, pointing to photos or the first letter of words to help people understand their speech. They may also use alternatives to speech such as graphic symbol board [Iacono & Johnson, 2004]. It is often the case that the cost of specialized, aided AAC devices is too high for the limited functionality they offer. Therefore, it seems reasonable to build AAC services based on information and communication technologies (ICTs) [Vučak et al, 2012], especially for mobile computer devices.

In this paper we have analysed the statistics regarding people with disabilities in Croatia, causes and types of their impairments and the healthcare they are entitled to by the national compulsory health insurance scheme, in order to properly recognize the needs and requirements of various potential AAC users. Referring to ICT-based AAC services as services that enable symbol-based human-to-human communication and human-computer interaction (HCI) in a networking environment [Car et al, 2012], we have proposed a brief taxonomy of AAC services regarding their input and output features according to the type of users' impairment. Also, we have discussed needs and perspectives for using such services in independent and assisted living surroundings to supplement, not replace, some of the aids usage by persons with disabilities, especially the ones with multiple impairments.

The paper is structured as follows: section 2 gives a background on relevant last year's statistics regarding people with disabilities in Croatia, and corresponding inclusion policies. Section 3 explains the needs and perspectives of AAC usage to support independent and assisted living of persons with disabilities. Section 4 provides an expanded discussion which summarises existing challenges, contribution and proposed future work in the area.

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2. BACKGROUND

According to the Croatian "Census of Population, Households and Dwellings 2011", the total population of Croatia is 4,290,612. The population density is 75.8 inhabitants per square kilometre, and the overall life expectancy in Croatia at birth is 75.7 years. Since 1991, Croatia's death rate has continuously exceeded its birth rate; the natural growth rate of the population is currently negative. According to the Croatian Disabilities Registry, managed by the Croatian National Institute of Public Health [Baklaić et al, 2011], by 30 September 2011 there were 978,818 individual reports collected for 525,312 disabled persons, from which 316,501 were male (60.3%), and 208,811 were female (39.7%). Therefore, around 12.2% of Croatian population are disabled persons (male 7.3%; female 4.9%), compared to 16.6% in EU27.

2.1. Causes of disabilities in Croatia

The most common causes (by 94%) of disabilities or comorbid diagnoses, which contribute to the person's functional incapability, are: locomotors system impairments, mental disorders, other organs and organic system impairments and central nervous system impairments. More than one quarter of all persons with disabilities have multiple impairments. Table 1 shows the types of impairments in persons with disabilities, in line with the Act on Croatian Disabilities Registry [Baklaić et al, 2011].

Table 1: *The number (and percentage) of persons with disabilities in Croatia, by the type of their impairments*

Type of impairment	No.	%
Locomotor system impairment	*151,335*	*28.8*
Psychological disorder	*123,998*	*23.6*
Other organs and organic system	*120,750*	*23.0*
Central nervous system impairment	*95,845*	*18.2*
Mental retardation	*21,953*	*4.2*
Visual impairment	*17,990*	*3.4*
Speech and language impairment	*15,083*	*2.9*
Hearing impairment	*12,974*	*2.5*
Peripheral nervous system impair.	*12,296*	*2.3*
Congenital anomalies and chromosomopathies	*8,548*	*1.6*
Pervasive developmental disorder	*1,062*	*0.2*
Multiple impairments	*144,632*	*27.5*

2.2. Health insurance in Croatia

Regarding the Compulsory Health Insurance Act, disabled persons and other persons in Croatia who have been entitled to be assisted by another person in performing most or all vital functions according to special regulations are exonerated from co-payments for medical care. The same applies to persons with at least 80% physical disability pursuant to pension insurance regulations and the Act on Rights of Croatian Veterans from the Homeland War and Members of their Families, as well as physically disabled persons.

Orthopaedic and other aids for people with disabilities are defined by The Rulebook on Terms and Conditions for Realization of the Right to Orthopaedic and Other Aids of Croatian Institute for Health Insurance. The other aids include: eyesight and tiflo-technical (for the blind and semi blind), hearing and surdo-technical (for the deaf and hard of hearing), loud talking enablers, dental prosthetic and orthodontic devices, etc. Naturally, AAC usage makes great benefits coping with speech and language impairments [Ivšac Pavliša et al, 2012], but can also be useful for accomplishing some communication-related tasks for persons with multiple impairments (e.g. blindness with deaf-mutism, blindness or deaf-mutism with intellectual impairments, etc.).

2.3. Inclusion policies in Croatia

Five years ago, the Government of Croatia issued "National Strategy of Equalization of Possibilities for Persons with Disabilities from the Year 2007 till the Year 2015" with the goal to advance and strengthen a protection of persons with disabilities and children with developmental difficulties [Kosor, 2007]. Some of the ICT-related goals and activities in the strategy clearly state the following:

- To promote accessibility to new information and communication technologies and systems;
- To use new technologies for improving independence and quality of life of persons with disabilities;
- To make communication systems more accessible to persons with disabilities by means of new technologies;
- To provide various types of assistance in the field of communications to persons with disabilities to facilitate access to public facilities and areas open to the public.

Many of the stated activities were already executed, like production of training materials for ICT (book in Braille and digital didactic content) for blind [Balković et al, 2009].

In March 2012, Croatia published a five-year plan for deinstitutionalization of people with disabilities out of institutions and into the community. The plan pledges to move 30% of people with intellectual disabilities out of institutions by 2016 and 20% of people with mental disabilities by 2017, while developing community-based support for these populations, like organized housing [HRW, 2012].

3. INDEPENDENT AND ASSISTED LIVING AAC

Inclusion policies briefly described in the previous section direct towards assisted living (AL) for persons with disabilities, but can also work out by the independent living (IL) principles, like equal opportunities, self-respect and self-determination. While AL concentrates on providing assistance and supervision of people with disabilities in conducting their daily activities, outside the primary healthcare system, in order to ensure their well-being and safety, IL aims to equip them, as much as possible, with the same choices in every-day lives other people have. Both independent and assisted living approaches inevitably demand for AAC systems and services based on ICTs, in order to increase the quality of life (QOL) for people with disabilities. But, these services ought to be designed to carefully meet users' needs, wants and abilities, taking into account a context of use, involved users and their relations, and principles like simplicity, supplementing needs, and trustworthiness [Belani, 2012].

In the context of user devices affordability, wide-spreading of advanced mobile devices, like smart phones and tablets, make them perfect candidates for development and deployment of AAC services. Evaluation of technical possibilities and limitations of mainstream and specialized (e.g. e-readers) tablet devices, available on the market, for symbol-based AAC has been conducted [Dolić et al, 2012]. Taking usability requirements as crucial for successful AAC services, component-based development process has been introduced, counting on reusing AAC components [Vučak et al, 2012]. Nevertheless, showing that mobile devices are far from being the only solution for AAC, some research has been done utilizing tangible user interface (TUI), showing its high usability for people with physical impairment and severe to mild learning difficulties [Zajc and Istenič Starčič, 2012].

3.1 Types of mobile AAC services

Design of AAC systems and services should cope with all of person's major disabilities, in order to provide a mean for successful communication, but not emphasizing some other user's inability in the same time. For example, if a non-talking child with severe motor impairments is given a communicator application [Blagajić et al, 2012] to e.g. pick his favourite food, the major button on user interface should be adjusted in a way that the child can reach it [Ivšac Pavliša et al, 2012], otherwise the service is not usable for him. In order to match the type of given impairment with desired AAC functionalities, we have put together a brief taxonomy of AAC services that shows which service feature could help which impairment. Table 2 shows some common types of aided, mobile AAC systems, along with typical input/output features.

Table 2: *Types of ICT-based mobile AAC services*

Type of impairment	Input features	Output features
Locomotor system impairment	*Adjustable GUI; Execution by a voice command*	*Text-to-speech; Sound alerts; Audio messages*
Psychological disorder	*Picture selection; Object tracking*	*Visual attention; Sound imitation*
Mental retardation	*Known photos & symbol selection*	*Photos, symbols; Audio messages*
Visual impairment	*Vibration-by-selection*	*Sign-to-speech; High-contrast*
Speech & language impairment	*Sign-to-speech; Signs, message composition*	*Texting; Speech; Symbol composition*
Hearing impairment	*Text & symbols; Touch & vibrate*	*Text & symbols; Visual effects*

3.2 Example of a mobile AAC service

As seen in the previous section, AAC systems and services can offer various communication methods, depending on the type and severity of user's disability. In order to adjust the graphical user interface (GUI) to users' needs, skills and limitations, AAC services can recognize and quantify user's skills on using the interface, like for example in the Calibrator service developed as a part of e-Accessible service system [Blagajić et al, 2012], all within the ICT-AAC project in which the first author also conducts his PhD research [Ict-aac.hr, 2012]. Calibration process here is being done by calculating UI parameters to optimize the symbol size, object position on screen, contrast and background, and choosing the most suitable symbol gallery.

4. DISCUSSION

Over the years, AAC has been proven as highly beneficial for improving speech, literacy, learning, understanding, employment, and quality of life for persons with CCNs [Car et al, 2012]. Nevertheless, specialized, aided AAC devices, often with one-button functionality, seem too expensive and many of them are not even available for procurement on some smaller national markets (e.g. in Croatia), but have to be specially ordered from abroad. Some of the issues that arise in this case are foreign language support only (e.g. "Talking Photo Album" in English), inability to adapt the same device for various users and purposes (e.g. the response time for a Down syndrome child and an autistic child is different), etc. Therefore, it makes a lot of sense to set a common ground for building a national ICT-based AAC research and development community [Stančić et al, 2011]. Multidisciplinary collaboration has already been established [Stančić et al, 2011], lack of which would be a showstopper for development of successful AAC services.

A platform model for development of accessible symbol-based, e-services has been developed [Car et al, 2011]. AAC Body of Knowledge has also been developed in Croatian language [Ict-aac.hr, 2012]. Further research and development efforts, among others, include establishing and verifying practical AAC-specific development processes, especially the ones for early phases in the lifecycle, like usability requirements elicitation, service prototyping, and user experience surveys.

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