Connected Computer Aided Communication

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ABSTRACT

Computational support for enhancing the quality of conversational output of electronic communication aids is limited to literacy-based devices, even though most users are not literate. Current systems for pre-literate users are dependent on carers for input and content maintenance; no computational support is given in generating and retrieving appropriate utterances. Utilizing the Social Web and the computing power afforded by online connectivity opens up exciting new possibilities of supporting communication aspects that so far have not been adopted by the communication aids industry. This is an area of high potential for impact and innovation as recent projects have shown.

Categories and Subject Descriptors

D.2.2 [Software Engineering]: Design Tools and Techniques – User interfaces; H.5.2 [Information Interfaces and Presentation]: User Interface; I.2.7 [Artificial Intelligence] Natural Language Processing – Language generation.

General Terms: Design, Human Factors.

Keywords: WiFi Network, Augmentative and Alternative Communication (AAC), Personal narrative, Language development, Assistive technology, Disability, Cerebral Palsy, Mobile applications, Voice Output Communication Aid (VOCA), Speech Generating Device (SGD)

1. INTRODUCTION

Individuals with little or no functional speech often rely on electronic communication aids to provide an alternative means to natural voice. The majority of this user group is pre-literate, depending on others to add vocabulary (words, sentences and phrases) to their device which they retrieve using symbol based access. Accessing such information depends on the user remembering what is in the system and how to retrieve desired items. In addition, users need to know what vocabulary they wish to retrieve and in what order; this is a fundamental challenge when many users are in the process of developing language and communication skills. Communication output is characterized by single words responses, making it difficult for users to experience successful communication, which seldom goes beyond simple needs-based interactions such as *I am thirsty*. Indeed research shows that users, in general, are limited to short or one word utterances; they show little motivation and in many cases stay passive when it comes to communicating with others [9].

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2. ACCESS TO COMPUTATIONAL LANGUAGE SUPPORT

2.1 State of Technology

Supporting language development for individuals with congenital severe speech and physical impairments (SSPI) using Augmentative and Alternative (AAC) technology raises many challenges: a) Pre-literate users rely on others to supply vocabulary on their device; b) Introducing new vocabulary is dependent on manual updating by a carer or therapist; c) Accessing appropriate vocabulary depends on extensive training and memorization. Current AAC systems offer no computing support for supporting vocabulary input or retrieval. Instead carers and users are trained to use well-researched methods to organize vocabulary. Any concept of facilitating the automatic development of vocabulary, its retrieval and indeed any long term access to once information is stored, is nonexistent. This leads to the loss of the users' ability to share and reflect on lifelong personal experiences with others, fundamental to developing self-image [5].

2.2 NLG and AAC

Natural Language Generation (NLG) techniques have been applied to AAC in an attempt to support more effective conversation in the research context. For example, Newell et al. [7] demonstrated that limited input from AAC users could be translated into complete phrases; the Compansion project [6] expands telegraphic user input, such as *Mary go store?*, into complete utterances, such as *Did Mary go to the store?* Dempster [3] is working on using NLG to support social interaction for adult AAC users with various degrees of literacy. An example of harvesting information from the internet to increase access to vocabulary (in this case to inform word prediction) is the Webcrawler project [4]. These examples however do not address the need for symbol access for the majority of pre-literate users.

3. SUPPORTING CONVERSATION USING NLG AND ONLINE CONNECTIVITY

The following examples illustrate how NLG, online connectivity and the Social Web can successfully support access to conversational narrative phrases for pre-literate users AAC users.

3.1 NLG

An NLG system specifically designed to support language development in children with complex communication needs was STANDUP [8]; this system provided symbol supported access to narrating novel punning riddles which were automatically generated using NLG technology. Nine children with SSPI successfully trialed the system in a special school. The initial software needed extensive computing power, limiting the system at the time to hi-spec computer hardware.

The current version now generates the riddles on a remote server that can be accessed via a web interface[1]. Such an implementation potentially allows integration into mainstream AAC devices, making this technology viable for use in an interactive conversation.

3.2 Online Connectivity

An example of a system using both NLG technology and internet connection to support language development for children with SSPI is the "How was School today...?" (HwSt) project [2]. Based on ethnographic requirements elicitation in a special needs school, the system was designed to automatically generate and provide utterances about personal experiences during a school day to support conversations between the child and their parents.

The system uses a camera mobile phone with an RFID sensor, which detects the user's location and interaction with objects and people, and sends this information to a remote server. The child's AAC device has online access to the server which uses data-to-text NLG technology to generate appropriate utterances using the collected data and other information, such as the child's timetable, so that the child can talk about their day. During an evaluation in a special needs school, the users were able to access messages from both the mobile phone and AAC device to support narrative-based communication in school and at home.

3.3 The Social Web and Human-Powered Assistive Technology

The emergence of a Social Web and the resultant increased access to human support could potentially provide near real-time assistive technology processing for people with accessibility needs; given a number of promising examples of human-powered access technology are already in existence [1]. For example, the VizWiz project[2] produced an iPhone app that utilizes a range of human and automated methods, including Amazon's Mechanical Turk[3] service, to enable users to upload images with an audio question relating to the image, and rapidly receive an accessible text response. VizWiz is targeted as an assistive technology for people with visual impairment to rapidly receive accessible information extracted from, for example, an image of a bus timetable or restaurant menu.

The potential of human-powered assistive technology, supported by advances in web connectivity and the resultant increase in available access to human judgment and processor power offers particular potential to augmenting online NLG-based AAC.

4. CONCLUSION

The examples above show the possibilities of using online connected systems to harness human and computing power to provide enhanced access to language and speech. However, the applications remain isolated systems with little merging of functionality. In a future scenario, a remote service centre could store and manage an individual's data and communicate online with a user's AAC device. The development of an infrastructure for data transfer between AAC devices with an openly available system architecture and data transfer protocol would allow for AAC Content Generation services to communicate with devices from different manufacturers. As an example, data such as location, interaction with people and objects, images, and even physiological status could be used to automatically generate conversational utterances using data-to-text technology to reflect personal experience and emotion. This could for example support language development for users with language impairments and severe learning disabilities. User statistics and therapists input could be engaged to dynamically and remotely adapt the interface and content of a device to the users' capabilities to support their progress. Following user centred design methodologies, these systems can be evaluated at both formative and summative levels.

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6. REFERENCES

1. Bigham , J., R. Ladner, and Y. Borodin, *The Design of Human-Powered Access Technology*, in *ASSETS 11 - ACM Conference on Computers and Accessibility*. 2011: Dundee, Scotland.
2. Black, R., et al., *A New Tool to Support Interactive Narrative Experience for Children with Communication Disorders*, in *14th Biennial Conference of the International Society for Augmentative and Alternative Communication*. 2010, International Society for AAC: Barcelona, Spain.
3. Dempster, M., N. Alm, and E. Reiter, *Automatic generation of conversational utterances and narrative for Augmentative and Alternative Communication: a prototype system.* , in *Proceedings of NAACL-10 Workshop on Speech and Language Processing for Assistive Technology*. 2010: Los Angeles, USA.
4. Luo, F., D.J. Higginbotham, and G. Lesher, *Webcrawler: Enhanced augmentative communication*, in *CSUN Conference on Disability Technology*. 2007: Los Angeles, USA.
5. McCabe, A. and C. Peterson, *Getting the story: A longitudinal study of parental styles in eliciting narratives and developing narrative skill*, in *Developing narrative structure*, A. McCabe and C. Peterson, Editors. 1991, Lawrence Erlbaum Associates: Hillsdale, NJ. p. 217-253.
6. McCoy, K., C. Pennington, and A. Badman, *Compansion: From research prototype to practical integration.* Natural Language Engineering, 1998. **43**(73-95).
7. Newell, A., S. Langer, and M. Hickey, *The role of natural language processing in alternative and augmentative communication.* Natural Language Engineering, 1998. **4**(1): p. 1-16.
8. Ritchie, G., et al., *The STANDUP Interactive Riddle-Builder.* IEEE Intelligent Systems, 2006. **March/April**: p. 67-69.
9. Waller, A., *Communication Access to Conversational Narrative.* Topics in Language Disorders, 2006. **26**(3): p. 221-239.

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[1] http://www.abdn.ac.uk/jokingcomputer/joker.shtml

[2] http://hci.cs.rochester.edu/vizwiz/

[3] http://www.mturk.com