Mobile Aid for Deaf people learning Computer Literacy Skills

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Abstract- This paper discusses a prototype of a learning aid on a mobile phone to support Deaf people learning computer literacy skills. The aim is to allow Deaf people to learn at their own pace which in turn reduces the dependence on a teacher to allow the teacher to assist weaker learners. We studied the classroom dynamics and teaching methods to extract how lesson content is delivered. This helped us develop an authoring tool to structure lesson content for the prototype. A prototype has been developed using South African Sign Language videos arranged according to the structure of pre-existing lessons. The technical goal was to implement the prototype on a mobile device and tie the resulting exported lesson content from the authoring tool to a series of signed language videos and images so that a Deaf person can teach him/herself computer literacy skills. Qualitative preliminary results from user testing found the prototype successful in allowing Deaf users to learn at their own pace thereby reducing the dependence on the teacher.

Index Terms— Assistive Technology; Authoring Tools; Co-design; Computer-assisted instruction; End User Applications; Mobile Applications;

I. INTRODUCTION

This paper describes our initial experience with a mobile prototype that supports teaching computer literacy skills to Deaf people with low literacy, using South African Sign Language (SASL) as the medium of instruction. Deaf with a 'D' is distinguished from deaf or hard-of-hearing in that Deaf people use a signed language to communicate, thereby defining their culture much like other groups who use textual languages like English. Deaf people are often not literate in spoken and written languages [4]. Acquiring computer skills necessitates knowledge of a written language. Learning involves learning the written language in order to learn these skills.

Bridging communication between Deaf and hearing people is an ongoing research area, extending to different communication contexts. Our latest strategy has been to focus on particular constrained contexts (or scenarios) where a limited collection of interactions can be scripted and incorporated into pre-recorded SASL videos. SignSupport project previously investigated interactions between doctor-Deaf patient [6] and pharmacist-Deaf patients [2, 5].

In this paper we examine another application context, namely adult computer literacy training, for the SignSupport project. We investigate how to support Deaf people learning computer literacy skills using the International Computer Driving License (ICDL www.icdl.org.za) approved curriculum, e-learner (www.e-learner.mobi), developed by Computers 4 Kids (www.computers4kids.co.za). Currently, teaching Deaf learners involves the teacher reading instructions from the e-learner manual and signing the content to the learners. In the process all Deaf learners must look at the teacher due to the visual nature of SASL. This approach inhibits the progress of faster learners and so the pace of the class is dictated by the weaker learners.

We designed an XML specification to structure lesson content and specify resources used in the lessons. We created an authoring tool to create lessons and export lessons as XML data ready to be used by the display system of SignSupport running on a smartphone. The authoring tool allows domain specialists such as teachers to create content without needing a programmer. We have tested the system in a live lesson and report on our findings.

The rest of this paper is organized as follows: Section II covers related work in computer literacy. Section III discusses the testing. Section IV discusses the results. Section V concludes and outlines future work.

II. RELATED WORK

A project carried on in Slovenia, called DISNET, focused on providing an alternative way of learning computer literacy using accessible and adapted e-learning materials. It used multimedia materials in a web-based virtual learning environment. The aim of the project was to increase computer literacy among Deaf and hard of hearing unemployed people using the ICDL e-learning material [3]. The system was designed for people who have access to computers, high speed broadband Internet but without basic computer or web browser experience.

III. RESEARCH METHODOLOGY

We assembled a collaborative interdisciplinary team comprising of Deaf end users, Computer Science students and a Deaf education specialist. We undertook community co-design [1] following an ethnographic action research methodology. The Deaf Community of Cape Town (DCCT – a grassroots NGO) plays a steering role and the research team is tasked to find solutions that are feasible for the team to take forward together. We also collaborated with two other researchers, from the University of Cape Town (UCT) and the University of Western Cape (UWC) to co-design an XML specification that is used to structure lesson content and is generated by an authoring tool. The design of the XML specification was based on the structure of the e-

learner lesson as well as a means to manage the lesson assets (pictures and SASL videos). The first version of XML was an abstraction of the hierarchical structure of the e-learner.

SignSupport does not entirely eliminate the need for a teacher. The teacher is still tasked to describe new concepts to the Deaf learners especially where there are no signs yet for these technical concepts in SASL. The system maps the content of the e-learner and serially displays the content in SASL videos and images. We recorded the videos aided by a SASL interpreter using a script created from the e-learner. The prototype is scaled for mobile screens. The interface is designed such that the video is 70% of the display real estate [5] and the navigation buttons, image and text fill up the rest of the space (Figure 1).

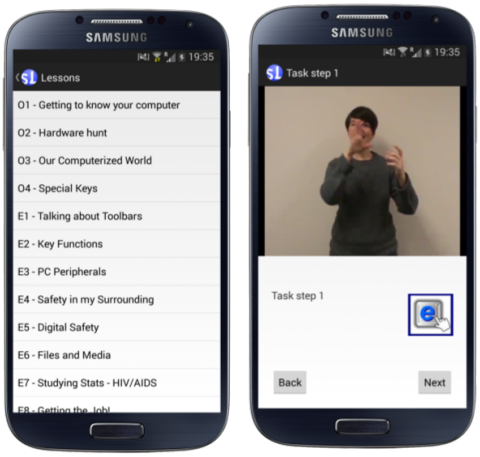

Figure 1: ***Interfaces of SignSupport's lesson list and lesson task detail screens.***

After verifying functionality in the laboratory we performed our first live test of the prototype with five Deaf ICDL learners (all DCCT staff). The mobile prototype was loaded on five Samsung Galaxy S3[1] smart phones. The testing was conducted at DCCT. No incentives were given to the participants to test the prototype. The project was explained to the participants in SASL after which each person evaluating the prototype signed a consent form. An interpreter, in this case the teacher, facilitated communication between the researcher and the Deaf participants during the test. The testing was done in four parts. First, the participants were trained on how to use the system. Second, the participants tried to learn a practice lesson for 20 minutes, followed by working on a lesson for 30 minutes with minimal help from the teacher and lastly a focus group to gather feedback from the Deaf users. Video recording and note taking were used to record observations in the session.

IV. RESULTS

This test was the first time the participants were exposed to the prototype and they all found the interface easy to use. Two participants had difficulties locating the back button on the interface even after training. All participants understood the information delivered by the application via the SASL videos.

All participants noted that the signing in the videos was different to theirs, indicating dialectal difference in the signs used in the SASL videos. In this case, potentially stronger participants helped weaker participants understand the instructions. We also observed, during the testing, that Deaf participants were individually working at their own pace, and the teacher only helped when the participant asked for it, which did not affect the other participants working. Some Deaf participants noted a mismatch between the instructions and what they expected to see on the computer. The mismatch occurred due to unforeseen steps such as the monthly password that is entered in the software to access the lesson content. Suggestions for redesign included adding frequently asked questions (FAQ) and a glossary of terms and clearer explanations in the SASL videos.

V. CONCLUSION AND FUTURE WORK

We presented a system that allows Deaf users to learn computer literacy skills by having content in SASL videos. We observed that the system allows for Deaf users to work on their own, with or without the help of a teacher. We also mentioned a design of an XML specification for a content authoring tool that is used by the teacher to create lesson content for the mobile application.

Future work will involve verification of the SASL videos to address instructional inconsistencies, incorporating the glossary and the FAQ. Collection of data via interviews with the teachers and focus groups with the Deaf learners will be used for the next cycle of research.

VI. REFERENCES

[1] Blake, E., Tucker, W., Glaser, M. and Freudenthal, A. 2011. Case Study 11.1: Deaf Telephony: Community-Based Co-Design. *Interaction Design: Beyond Human-Computer Interaction*. Y. Rogers, H. Sharp, and J. Preece, eds. Wiley. 412–413.

[2] Chininthorn, P., Glaser, M., Freudenthal, A. and Tucker, W.D. 2012. Mobile communication tools for a South African Deaf patient in a pharmacy context. *Information Society Technologies-Africa (IST-Africa). Dar es Salaam, Tanzania: IIMC International Information Management Corporation*. (2012), 1–8.

[3] Debevc, M., Povalej, P., Verlic, M. and Stjepanovic, Z. 2007. Exploring usability and accessibility of an e-learning system for improving computer literacy. *International Conference in Information Technology and Accessibility* (Hammamet, Tunisia, 2007).

[4] Glaser, M. and Lorenzo, T. 2007. Developing literacy with Deaf adults. *Disability and Social Change: A South African Context*. 192–205.

[5] Motlhabi, M., Glaser, M., Parker, M. and Tucker, W. 2013. SignSupport: A Limited Communication Domain Mobile Aid for a Deaf patient at the Pharmacy. *Southern African Telecommunication Networks and Applications Conference (SATNAC)* (Stellenbosch, South Africa, 2013).

[6] Mutemwa, M. and Tucker, W.D. 2010. A mobile Deaf-to-hearing communication aid for medical diagnosis. *Southern African Telecommunication Networks and Applications Conference (SATNAC)* (Stellenbosch, South Africa, 2010), 379–384.

[1] http://www.samsung.com/za/consumer/mobile-phone/mobile-phone/smart-phone/GT-I9305RWDXFA-spec

George Ng'ethe received his BSc Honours degree in 2012 from the University of Cape Town and is presently studying towards his MSc. degree at the same institution.