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Software Development Kit Based Development of Assistive Applications

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Abstract. The rapid pace of technological advancement and its consequential widening digital divide has resulted in the marginalization of the disabled especially the communication challenged. The dearth of suitable technologies for the development of assistive technologies has served to further marginalize the communications challenged user population and widen this chasm even further. Given the varying levels of disability there is an inherent requirement for customized solutions. This paper explains the use of a Software Development Kits (SDK) for the bridging of this communications divide through the use of an Assistive Application Development Kit for development of assistive applications that meetkey requirements of communications challenged users as well as identification of appropriate frameworks for furthure development initiatives.

Keywords: Disability, Assistive Technology, Communication, Software Development Kit

1. Introduction

The recent technological advances have transpired into faster data transfer, larger data volumes and cheaper data transfer capabilities [1]. This in turn is spurning the rapid deployment of digital technologies especially in the field of communications. However, these advances in the digital arena a majority of these advances have not trickled down to disabled persons, in particular developments in telecommunications have failed to include the disabled [2], leading to a further widening of the digital divide from the perspective of the disabled and even more so from those that face communication challenges.

Despite the availability of numerous studies into the prevalence, causes, and effects of physical, mental, learning and communication disabilities (e.g.: the Sri Lankan Ministry of Social Welfare 2003 census into disabilities and the Christopher and Dana Reeve Paralysis Foundation 2009 census into spinal cord injuries) there are insufficient studies conducted with regard to the provision and success of ICT solutions aimed at social inclusion for the disabled, especially via communications.

This paper attempts to address shortcomings associated with the provision of accessible communication technologies for the disabled by firstly extrapolating from vertically targeted studies and censuses in a holistic manner. Section 2 will ascertain the demographics of those affected by disabilities based previous census. Next this paper this paper intends to chart the use of emerging technologies that could be adapted for provision of communication assistive technologies for the disabled. This is followed by a discussion of the applicable assistive technologies.

The remainders of the sections are divided as follows: Section three discusses justifications for the purposed approach. The manner of the execution of the research, its results and the subsequent case studies are detailed in sections four, five and six respectively. Finally this paper is concluded by the summarization of this research leading to future research pathways for the development of assistive technologies especially for the communication challenged.

2. Target user base

Numerous studies (British Department of Health (2001), Weerasinghe et al, (2007) and the Dana Reeve Paralysis Foundation (2009)) have revealed that there is a high prevalence of disabilities in our population.

People with disabilities find inclusion into society difficult especially owing to their communication disabilities [3].

It has been proven that the use of computers and the Internet can not only enrich the lives of people with disabilities but can also enhance independence and facilitate a new channels of communication [3], [4]. However, regrettably only 23.9% of the persons suffering from disabilities even in the United States are likely to have access to computers [4].Add to this the rapid pace of technological advancement which results in reduced accessibility to telecommunications for disabled people, thus depriving them of their basic right for communication [5].

3. Use of assistive technologies

The varying nature of disabilities requires customized solutions [6], for instance some who suffer from communications disabilities excel at expressing their views via keyboard whilst few others benefit from the use of visual symbols and related commercial software such as Makaton or Widgit's Rebus which translates text to symbols and vice versa [3]. The use of symbols in the facilitation of communication in present societal contexts is readily apparent [7]. Samples of such symbols are given Fig. 1 below:

Fig. 1: Common symbols used for communication in present society

Symbols as given above could be used as an alternative and augmentative communication system as well as for enabling access to information, promoting of reading and writing and therein enhancing independence and self advocacy [7]. Speech recognition and synthesis too has documented benefits in certain contexts especially in its use with the disabled [8]. The particular format of speech recognition used is critical when used in the context as an assistive communication tool for disabled [9].

The use of a Software Development Kit (SDK) based development model provisions better development processes, simplification, cost reduction and better re-use of process, platforms and data [10]. Given the above it is clear that the SDK model provision greater reusability, flexibility and adaptability. This is of paramount importance in situations such as in providing customized development for the disabled wherein each disabled user is provided customized and specific application to suit his/her needs.

Whilst there is an abundance of empirical research on the benefits in the use of symbols for communication (e.g.: studies conducted by Widget 2000 and 2004) there is a serious dearth of such research in the sphere of speech recognition and speech synthesis as assistive technological components for the communications challenged. This dearth is further exuberated in the use of Assistive Technologies Development Kits (ATDK) as this study has show that there are none existent.

4. Use of assistive technologies

The research herein aims to ascertain the suitability of a comprehensively structured, modular, layered and reusable Assistive Technologies Development Framework (ADTF) based approach towards the provision of above assistive technologies through laboratory based evaluation, sample population statistics and surveys.

The laboratory based evaluation will be conducted using a Test bench basedapproach where a common application platform will be developed to test the functionality of the components. The resulting text output and wave files will be evaluate for accuracy.

The Test bench will also serve as the start for the development of the end user application which be issued to each end user for the sample population statistics and survey based evaluation of each component.

5. Methodology

The study conducted initially with the participation of 268 volunteers sourced from the staff of Commonwealth Rehabilitation Services Australia. These volunteers were augmented with 110 other disabled volunteer from Paraquad as well as those who subscribed via the internet.

The foundations for the sample population statistics were based on the benefits of participatory research methods demonstrated in the LEXDIS study [11]. This method required the active participation of the end users in specifying what their requirements are and what their benchmark of success of the research is.

Here key research parameters were obtained through surveys conducted amongst the selected sample population as well as direct personal interviews with each participant. Based on the key functionality requirements garnered from the above phase all popular SKDs were evaluated for their capabilities towards matching these requirements and three were selected. Each selected SDK resulted in the development of an assistive application containing components of that SDK contained features for the capturing of the original entered text/captured voice and synthesized voice/translated text as raw WAV or text files, in separate files named in a numerically and chronologically ordered manner for subsequent analysis.

The above sample population was randomly divided into three groups. Each group was allocated an executable based on one SDK and each member of a group from the above sample population received a binary file and was encouraged to utilize the assistive application for a minimum of thirty (30) minutes a day for One Hundred and Eighty (180) days. The sampled population was required to provide their feedback via an online evaluation form wherein they rated each assistive application, as well as provided their feedback on each assistive application.

Separately laboratory testing of the shortlisted SDKs was performed using a test bench approach were each was subjected to evaluation. Laboratory testing using the test bench was performed in three (03) phases. Components that incorporated speech recognition capabilities were tested directly whilst components that lacked such facilities were augmented using the Microsoft Speech API version 5.1.

During phase one (01), the test bench was utilized to perform testing on Dialing out, Displaying of Incoming Calls, Answer Capability, Dual Tone Multi Frequency Detection and Generation. Here the text 'Hello, this is a test, how are you today' as well as a wave file that contained a clear vocal recording of this text by a Native English male speaker was transmitted by Peer A to the Peer B which displayed its output in the Edit Box titled Remote Text. The results were collected and analyzed.

In Phase Two (02), Voice Synthesis and Recognition, was tested. Here the functions of the telephony component that were tested in phase one were retested together with its Voice Synthesis and Recognition capabilities.

Phase Three (03) expands on the tests conducted during Phase Two (02) by testing the similar functions as well as Speech Recognition and Synthesis capabilities but induces adverse network conditions in order to ascertain the quality of jitter correction and buffering provisioned by the components. This was conducted using SIPInspector to feed RTP packets to the other SIP end point in order to create network conditions simulation of packet losses or silences..

6. Experimental results

The WAV file were analyzed and wave files were compare using SFS release 4.7 (version 1.7) where Waveform, Wideband and Narrowband spectrograms were obtained and compared whilst the text files were compared against the original text read by the speaker or typed in.

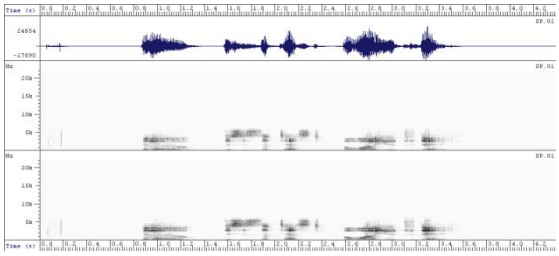

Fig. 2. Test Waveform, Wideband and Narrowband spectrograms

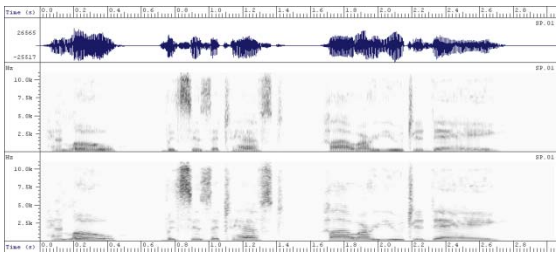

Fig. 3. Swincom Waveform, Wideband and Narrowband spectrograms

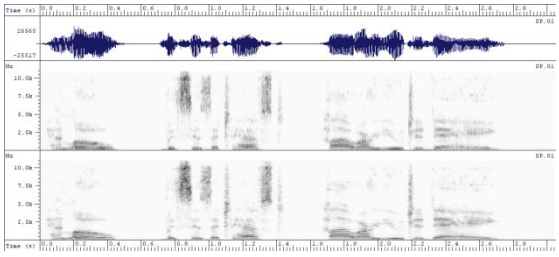

Fig. 4. PortSIP Waveform, Wideband and Narrowband spectrograms

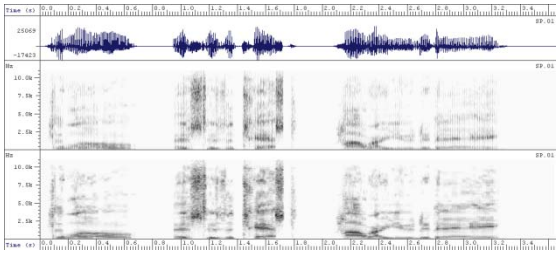

Fig. 5. VaxVOIP Waveform, Wideband and Narrowband spectrograms

Here Fig. 2 represents the Waveform, Wideband and Narrowband spectrograms of the test waveform (the raw wave file of the spoken text). Fig. 3 shows the waveforms and spectrograms for the generated output from the application that used the Swincom components. Here the marked differences in voice quality are clearly evident. Fig. 4 shows waveforms and spectrograms for the generated output from the application that used the Portsip components. Here there are marginal waveform differences between the end user applications using both Swincom and Portsip components but significant differences in the spectrograms. Finally Fig. 5 Shows the wave form and spectrograms of the output as decoded by the VaxVoip component showing clear distortion in both the waveforms as well as spectrograms highlighting a markedly poor output quality from this application.

End user feedback from the group who utilized the Swincom product, suggests that under normal conditions Swincom featured better during direct output to the Public Switched Telephone Network (PSTN) based endpoints. This group also used the product for the whole trial period. Whilst 52 percent were satisfied with the product the remainder suggested that improvements could be made in terms of better voice quality and higher detection rates.However, the 100% of group that used PortSIP based applications suggested that they had numerous complications when attempting to get basic words recognized and many found it irritating and all participants were not fully satisfied and requested substantial improvements. Meanwhile, all members of the group that used the application developed with VaxVoip stopped using the application within 3-8 days of the launch of the trial and would not utilize it for regular use and stated that they would not utilize it ever under situations that are business or mission critical as in directing field officers or for attempting dialogs with their.

7. Case studies

Based on the initial feedback from the above literature surveys as above research conducted a prototype Assistive Software Development Kit (ASDK) featuring VOIP, Speech Recognition and Synthesis, Symbolic language representation and Braille support was developed.

Utilizing the above ASDK specific assistive applications were developed for clinical trial by 15 selected participants suffering from communications challenges, over a period of three (03) months. During use and post usage the participants were subjected to a brief quality evaluation test.

The collated results of the above ASDK indicate that assistive applications developed specifically for individual disabilities were rapidly assimilated by the participants and are adopted into the their lifestyles due to the benefits of social inclusion that it provided.

8. Conclusion

The above research assessed the adaption of emerging technologies for the provision of communication assistive technologies for the disabled whilst serving as basis for research of assistive solutions for the disabled. But in light of the serious dearth in research as well as the creation of assistive technologies serves as a cornerstone in future development initiative.

The above research also indicates serious shortcoming in products available for the development of assistive technologies despite the vast market that presently awaits. The research into the development of assistive technologies using SDKs especially in the case studies indicated a genuine window of opportunity that until now had been sadly overlooked. Upon analysis of the above results it is apparent that by utilizing a based SDK approach to assistive applications provide for a faster and more productive application that is quickly adopted by communication challenged users.

Therefore, it is the recommended greater research into the development of an ASDK's specifically combining and integrating the advancements in ICT technologies for the development of assistive technologies yet catering to a person centered development approach towards catering for the unique individual requirements that each person and circumstance may warrant.

9. References

[1] R.Scott, W. Li. K.Cong, V. Hernandez, B. Kolner, in:Demonstration of an Error-Free 4X10 Gb/s Multiuser SPECTS O-CDMA Network Testbed, *IEEE Photonics Technology Letters*, Vol. 16, No. 9(2004)

[2] W. Jolley, in:When the Tide Comes In: Towards Accessible Telecommunications for People with Disabilities in Australia, viewed 10-04-2010, retrieved from (http://www.hreoc.gov.au/disability_rights/communications/tide.htm) (2003)

[3] D.Murray, A.Aspinall, in: Getting It: Using Information Technology to Empower People With Communication Difficulties.(2006)

[4] S. Kaye, in:Disability and the Digital Divide: Disability Satstics Center.(2000)

[5] R.Garrett, in: New technological options for people with physical disabilities, through the use of telecommunications equipment, Regency Park Rehabilitation Engineering, e-bility.com, viewed 10-04-2010, retrieved from (http://www.ebility.com/articles/telecommunications.php)(2004)

[6] Custom Solutions,Low Incidence, viewed 10-04-2010, retrieved from (http://www.customtyping.com/tutorials/at/low_incidence.htm)

[7] Widgit Software Ltd, Introduction to Symbols, viewed 15-04-2010, retrieved from (http://www.symbolsinclusionproject.org/symbols/index.htm)(2004)

[8] J.Noyes, in:Talking and writing-how natural in human-machine interaction? *Int. Journal on. Human-Computer Studies* 55(2001), p. 503-519

[9] C. Baber, &J. M. Noyes, in: Advanced control devices: Speech control- In User interface design for electronic appliances, Taylor & Francis,(2001), p. 190-208

[10] British Telecom Innovate and Design: Keeping an open mind: How BT's changing infrastructure has become a blueprint for new ways of doing business, viewed 10-04-2010, retrieved from (http://www.btplc.com/Innovation/Innovation/SDK/index.htm).(2010)

[11] J. Seale,M. Wald, and E.A. Draffan, in: Reflections on the value of participatory research methods in developing accessible design in higher education, University of Southampton(2009)