The Online Participatory DAISY Talking Book Production System (OPDAISYS): A Shared Information and Knowledge System for Print Disabled Students

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Abstract: The digital talking book is a significant technology for the print disabled community to access information or printed media. Many libraries and relevant agencies have launched the development of digital talking book services. DAISY (Digital Accessible Information System) is the published standard for the distribution of digital audio books and provides much easier access to content for the print disabled. However, the cost associated with using the standard is very high and there are also other problems in that it is time consuming to develop and requires a number of volunteers. The impact of these factors led the researchers to develop the Online Participatory DAISY talking book production System (OPDAISYS). The OPDAISYS describes a computer system that enables the interactive online presentation of DAISY books over the internet. The system operates in conjunction with internet technology by creating an opportunity for people to participate and share in the production of digital talking books. The components of OPDAISYS include content management, audio recording, audio improvement, DAISY automatic generate and online sharing and delivery module. The procedures were researched and evaluated by eleven expert reviews and a field experiment of sixty volunteers and thirty prints disabled. The results showed that the main goal of project had been achieved. The OPDAISYS provides excellent potential for the production of digital talking books. The system is easy, effective access to information and also implies an integrated performance of production method that can be upgrade to new versions of DAISY in the future.

Key words: Online system, digital talking books production, DAISY, print disabled, versions, Thailand

INTRODUCTION

Access to information and knowledge is very important for people. However, there are restrictions on access for certain groups of people. Print disabled (that is the blind, partially sighted, dyslexics and some of those with visual impairments), physically handicapped, learning-disabled find difficulty in accessing information even though they have human rights to access education, facilities and technology.

Print disabled persons should have similar opportunities to others. Contextually, the majorities of disabled persons are ignored and cannot access the technology and facilities (Coombs, 1995). Many studies have demonstrated the advantages of using information and communication technology for disabled people. These benefits include the enhancement of their daily functions and literacy, extension of social networks, improvement in independence and quality of life and the facilitation of empowerment (Davis et al., 2002). In recent years, technology has rapidly become more advanced and affordable. It has been used commonly as therapeutic or training media for disabled people (Aspinall and Hegarty, 2001). However, the useful assistive technologies can practically help handicapped people to access groups of information.

In the case of the blind, the technology for converting text to speech is very helpful. Unfortunately, information has been stored in a different languages, formats and locations. Most of it is available on the internet but a good deal of useful knowledge has been commercially stored in paper-based book form and is not easily accessible for the blind.

There is a published standard for formatting paper-based books to the Digital Talking Book format (DTB), commonly called DAISY or Digital Accessible Information System (ITA, 1997). For many years, DAISY has been made available to print-disabled readers on

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analog media such as phonograph records and audio cassettes. These media serve their users well in providing human speech recordings of a wide array of print material in increasingly robust and cost-effective formats. The DAISY allows the user to easily skip over or read footnotes and also offers the print-disabled user a significantly enhanced reading experience that is much closer to that of the sighted reader using a print book.

The additional goal of DAISY books is to develop and provide a system which is easily integrated into DTB production and which is able to make use of future technologies to provide equal or better access to the information in a book than is available to a fully able reader of a paper-based book.

However, there are several difficulties with DAISY book production. It requires a lot of facilities and equipment such as a sound studio, a sound control system, head set and DAISY convertor (Nielsen, 1993). In addition, the processes of DAISY book production are not cost effective as the expenses associated with publication are very high, the production process is time consuming and it requires the services of volunteers who need to be able to fit the book production into their schedule.

The researchers recognize the importance of the right of the print disabled to dignity, freedom and equality. They were approached and made aware of the challenges associated with DAISY book production and invited to become involved with designing a new way participatory way for sharing knowledge widely. The aim of this study was to create a new way to produce digital talking books via the internet.

It allows volunteers to participate in accessing, producing, improving and sharing DAISY books from their home via using a computer and high speed internet connection. This can decrease the need for facilities and cost. Moreover, the system can automatically edit and convert sound to the DAISY format. These media not only serve their users well in providing human speech recordings of a wide array of print material in increasingly robust and cost-effective formats but also create a society of participatory learning and a wide sharing of knowledge.

LITERATURE REVIEW

Review of DAISY books: The DTB, like analog talking books, renders audio in human or synthetic voice (Christensen and Margit, 2006). Additionally, the DTB can contain image files and a forthcoming version will also include a video playback capability that offers a wide range of features in order to provide services to a broader audience including deaf and hearing impaired people. The audio file must be either in MP3, WAVE, MPEG-1 or 2 layer III or MPEG-4 AAC format. The text of a book is marked up in Extensible Mark-up Language (XML), a World wide web Consortium (W3C) standard somewhat reminiscent of HTML, the language used for web pages. For use in digital talking books, the XML mark-up must adhere to a specific Document Type Definition (DTD) defining the legal building blocks of the XML file. The DTD for a DTB is publicly available through the DAISY web pages.

The synchronization is mediated by Synchronized Multimedia Integration Language (SMIL) files which ensure the parallel presentation of the text part and the audio part of a DTB. The SMIL files for DTBs follow a DTD of their own. SMIL is a W3C standard. The Navigation Control Center (NCC) consists of a navigation control file for XML applications (NCX) file which is an XML application structured in accordance to a separate DTD.

The NCX contains navigation points for both text and audio and can be likened to a table of contents. Each navigation point in the NCX is linked through a SMIL file to the corresponding location in the audio and XML textual content files providing direct access to that location. The NCX controls the global navigation and provides access primarily to relatively large parts of the document.

The NCX provides an overview of all the points in a text to which a user may navigate and offers direct access to selected structures in the book such as page numbers, notes and figures.

Once, an NCX item has been selected, local navigation such as movement within a list or table or among a group of words, sentences or paragraphs it becomes possible. DAISY DTBs are not required to contain all of the possible constituents mentioned previous (Nes and Stenberg, 2007).

The DAISY standard: The DAISY standard was started in 1988 by the Swedish Library of Talking Books and Braille, TPB (Punktskriftsbiblioteket, 2004). TPB served public libraries and print disabled university students with additional reading materials and they recognized the dissatisfaction with the then existing audio books. The DAISY consortium was established in 1996 and developed from time to time. In 1998, the DAISY 2.0 specification was issued from the DAISY (2005) consortium.

The DAISY 3/NISO DTB was established National Information Standards Organization (NISO, 2002). The current DAISY standard was revised to ANSI/NISO

Z39.86-2005 by National Information Standards Organization (NISO, 2005). During recent years, membership of the DAISY consortium has grown at a rapid rate; currently, close to fourty countries are represented within the Consortium. The DAISY consortium's mission is to develop the international standard and implementation strategies for the production, exchange and use of DTBs in both developed and developing countries with special attention to integration with mainstream technology and to ensure access to information for people with print disabilities (Tank and Carsten, 2007; Nes and Stenberg, 2007).

Review of print disabilities and DAISY: The focuses of this research were the print disabled and DAISY books. Print disability is defined as blindness, visual impairment, a learning disability (such as dyslexia) or a disability that prevents physically holding a book by Canadian National Institute for the Blind (CNIB, 2000). Often, print disabled people are perceived as information inhibited. But as digital information is increasing, the divide between print disabled and their access to information is decreasing (Coombs, 1995).

Instead of denoting groups within the society as information inhibited, one could as well view society as information inhibiting. In other words, disability may be viewed as contextual and thus removing designed obstacles (such as printed information is for the print disabled) is enabling the disabled.

Thus, it is particularly important that technological engineers, designers and developers avoid the creation of contexts that reinforce digital divides. The aim should be to find mediating formats that satisfy the demands of universal design that is formats that can be used by all members of society.

SYSTEM DESIGN

Systems can be successfully designed by considering the various aspects of the web-based environment such as technology, knowledge, conceptual theory, standard, human-computer interface design and system evaluation. A few frameworks are available for the development of web-based environments that support DAISY production. However, these factors are rarely taken into account in the design process.

Development of an environmental template: The system adopted a three-tier structure based on the client/server model. Three-tier client/server structure is formed by adding a Client Tier, a Middle-Tier and a Data-Tier into the conventional Client/Server (C/S) structure model.

Tier 1: The client-tier technologies are the group of components that run on the user side on the web-based application. Clients have no need to install any software except a flash player to access media on demand. It only once needs a plug-in setup of the flash player to work properly in any web-browser.

The client can get the client-tier components by downloading web-browsers via a web-server such as HTML (Hypertext Markup Language), DHTML (Dynamic HTML), JavaScript, PHP (Hypertext Preprocessor), AJAX (Asynchronous JavaScript and XML) and RED5/Flash player (the open source media streaming technology). The components will be automatically run on the web-browser.

Tier 2: The middle-tier proceeds to serve the content and provides some prerequisite information required in the client-tier. The components combined at the middle-tier include a media streaming server and a web server that integrates the media streaming technology, the noise reduction algorithm and the audio compression software. However, the media output from audio recordings is a FLV file format which has some noise and cannot be generated to the DAISY format. Therefore, the FFmpeg (the open-source audio compression software) and noise reduction algorithm have to be input into the system to convert FLV media type files to MP3 files.

Tier 3: The data-tier is the group of components that are run to generate the navigator for the generated of the audio files into DAISY format before they are sent to the database. The content of the format consists of the navigation specification and audio management. The file types that relate to the standard include:

- NCX (Navigation Control for XML applications) file used for storing the chapter content in a digital talking book
- SMIL (Synchronized Multimedia Integrated Language) used for storing the synchronized information of the multimedia in a digital talking book
- XML (Extensible Markup Language) used for storing the detail content of a digital talking book. However, the database is the most important component in this tier

MySQL which is the most popular open source database is used. It is a Relational Database Management System (RDBMS) that is based on Structured Query Language (SQL). MySQL has a small size and fast speed, so many small and medium websites choose it for their
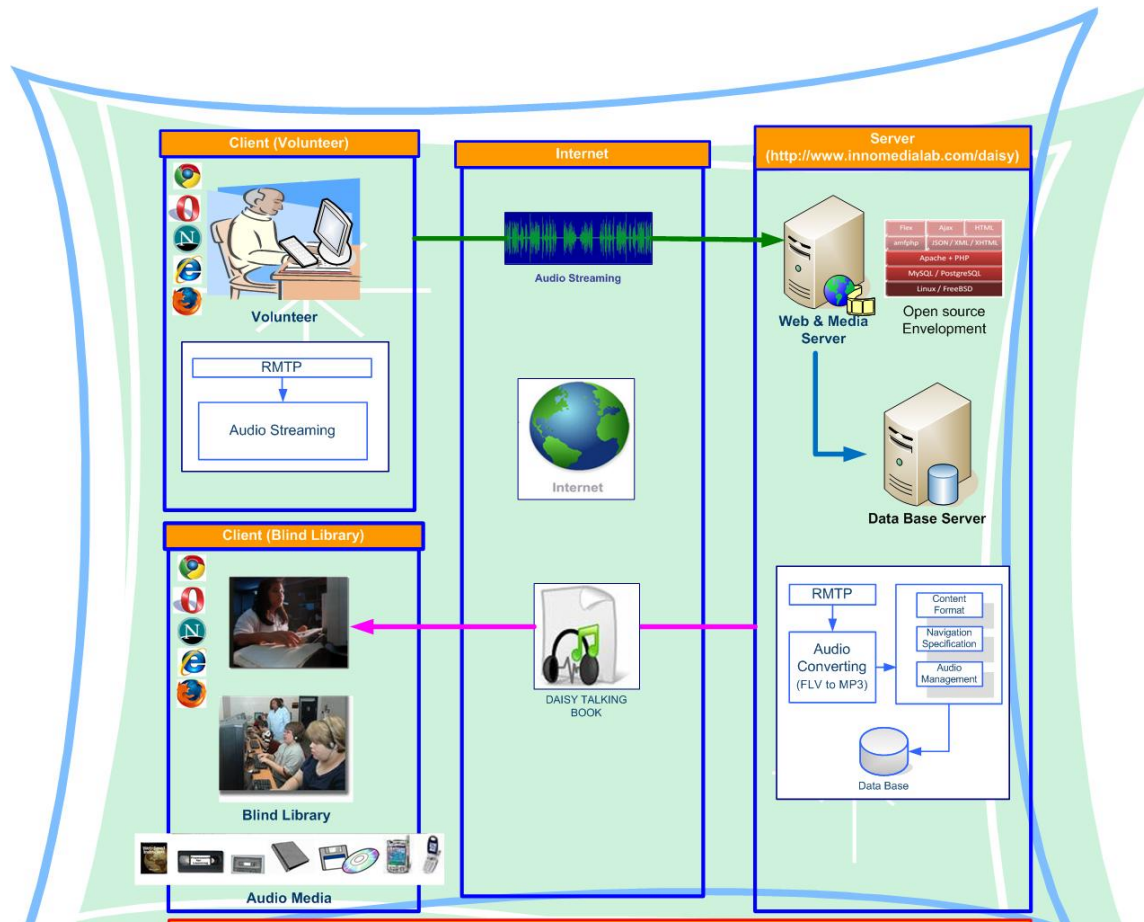
Fig. 1: The Online Participatory for Digital talking books (DAISY) production system (OPDAISYS)

website databases to reduce costs. Because of its advantages, MySQL was chosen to manage the database system in this research.

System approach: In Fig. 1, the user starts the process by selecting the preferred book from the content management module on a web browser. The web server will redirect to the audio recording module that is integrated with RED5 (the open source media streaming technology). The listed books will show on the web page and then the users can select and record the content. The users can improve the audio by pressing a short-cut key on browser. In the meantime, the audio is transferred to a placeholder in the prepared media server.

The transferring audio uses the Real Time Messaging Protocol (RTMP) for streaming all related audio files to the servers and stores the information in the database server which converts the audio from a FLV file to a MP3 file and generates to the DAISY format via XML and SMIL structure.

Finally, the web server responds to all requests from the end user (print-disabled, visual impaired and blind libraries). The end user can download the DAISY digital talking book from the server for use of basic competent (Chaisanit and Suksakulchai, 2009).

The Online Participatory Digital talking book (DAISY) production system (OPDAISYS): The online participatory digital talking book (DAISY) production system is started at http://innomedialab.com/daisy. As shown in Fig. 2, the OPDAISYS consists of four modules: content management, audio recording, audio improvement, DAISY automatic generate and online sharing and delivery module.

Content management module: This module shows the content of the book that users can search or select the preferred ones to create audio book, provide audio improvement and share experience in OPDAISYS. In addition, the users (or sub-users) can upload the

Fig. 2: Main webpages of OPDAISYS

additional increase content file in text and jpg format by themselves and this can be support the work of webmasters.

Audio recording module: With this module, users can control audio via the audio recording toolbar. The audio can be controlled by pressing a short-cut key such as play, stop, pause, record on the browser. Also, the user can upload audio files that have been recorded elsewhere.

Audio improvement module: The recorded audio that is completed in recording module can be improved by using this module. The users can improve incomplete or incorrect audio by listening and re-recording new tracks. In addition, the user can participate by voting and providing comments to recommend an improvement of the audio file.

DAISY automatic generate module: The purpose of this module is to generate the navigator to convert the audio file into the DAISY format. In general, the output from the audio recording module is in the FLV file format and has some noise that cannot be generated to the DAISY format. Therefore, this module uses an audio compression and noise reduction algorithm to convert the media type from FLV to MP3 file and generates navigator audio files such as NCX, SMIL and XML into DAISY format.

Online sharing and delivery module: The purpose of this module is to share and deliver the DAISY digital talking books to the public, especially the print-disabled, visually impaired and blind libraries to submit the specific book title and download DAISY digital talking book from the server. Also, the system fosters sharing and provides an opportunity for people to help each other more easily.

RESULTS AND DISCUSSION

This study used the four stages of evaluation created by Dick and Carey consists of:

- First expert review
- Small group evaluation
- Second expert review
- Field experiment

The evaluation criteria for determining the overall quality of the software testing, its clarity and impact were defined by ISO 9241-110 (2006) (International Organization for Standardization) and the satisfaction of the system was determined according to usability criteria, effectiveness, efficiency and satisfaction and followed ISO 9241-11 (1998) (International Organization for Standardization). The surveys used a 5-point Likert-type scale (1 = strongly disagree, 5 = strongly agree).

Table 1: Means and standard deviations for OPDAISYS prototype by expert review (1st)

Categories	Mean±SD
Concepts	4.40±0.37
Suitability for the task	4.00±0.40
Suitability for learning	4.10± 0.57
Suitability for individualization	4.00±0.49
Conformity with user expectations	4.30±0.28
Self-descriptiveness	4.01±0.42
Controllability	4.20±0.48
Error tolerance	4.10±0.38

Table 2: Means and standard deviations for OPDAISYS prototype by the small group evaluation

Categories	Mean±SD
Usability criteria	4.28±0.46
Effectiveness	4.25±0.45
Efficiency	4.39±0.50
Satisfaction	4.40±0.51

Table 3: Means and standard deviations for OPDAISYS prototype by expert review (2nd)

Categories	Mean±SD
Concepts	4.60±0.47
Suitability for the task	4.49± 0.40
Suitability for learning	4.40±0.37
Suitability for individualization	4.35±0.39
Conformity with user expectations	4.59±0.30
Self-descriptiveness	4.29±0.38
Controllability	4.50±0.32
Error tolerance	4.60±0.28

Table 4: Means and standard deviations for OPDAISYS prototype by the field experiment

Categories	Mean±SD
Usability criteria	4.30±0.36
Effectiveness	4.35±0.34
Efficiency	4.42±0.45
Satisfaction	4.49±0.47

First expert review phase: Eleven experts with a high level of expertise in this research field reviewed the prototype version of OPDAISYS to identify any deficiencies or problems and provided recommendations for its improvement. The evaluation criteria determined the overall quality of the software testing, its clarity and impact and the experts estimation provided a recommended design for the modification of the system. The overall quality of the system design was good and the degree of clarity of the system was rated higher than target levels.

The suitability of the concepts, the suitability for the task, suitability for learning, suitability for individualization, conformity with user expectations, the self-descriptiveness, controllability and error tolerance were shown to have means of 4.40 (SD = 0.37), 4.00 (SD = 0.40), (SD = 0.57), 4.00 (SD = 0.49), 4.30 (SD = 0.28), 4.01 (SD = 0.42), 4.20 (SD = 0.48) and 4.10 (SD = 0.38), respectively (Table 1).

According to the experts' suggestions, several designs were changed including a redesign of graphic figures and more options for editing messages (such as font color and size).

The small group evaluation phase: In this process, representative users identified and removed more prominent errors from the OPDAISYS prototype. Thirty users, focused on the suitability of the system for users. The level of satisfaction was determined through four categories of usability criteria, namely effectiveness, efficiency and satisfaction.

These showed means of 0.28 (SD = 0 .46), 4.25 (SD = 0.45), 4.39 (SD = 0.50) and 4.40 (SD = 0.51), respectively. Moreover, this phase also summarized and changed the main design in order to solve the usability problems that had been identified in the quality of the audio recording module and the user interface (Table 2).

Second expert review phase: In this process, the OPDAISYS prototype was finally reviewed again by eleven experts who exhibited a high level of expertise in these fields of interest. Their task was to identify any deficiencies or problems and provide recommendations for the improvement of the prototype. The evaluation criteria was determined in eight areas, namely suitability for the concepts, suitability for the task, suitability for learning, suitability for individualization, conformity with user expectations, self-descriptiveness, controllability and error tolerance. These had means of: 4.60 (SD = 0.47), 4.49 (SD = 0.40), 4.40 (SD = 0.37), 4.35 (SD = 0.39), 4.59 (SD = 0.30), 4.29 (SD = 0.38), 4.50 (SD = 0.32) and 4.60 (SD = 0.28), respectively (Table 3). The overall quality of the system design was good.

Field experiment phase: This process was carried out by sixty volunteers that had produced a digital talking book and thirty print disabled users. The study group assessed the effectiveness of OPDAISYS. The field experiment was also conducted to identify a way of evaluating the quality of users. The level of satisfaction was determined through four categories, namely usability criteria, effectiveness, efficiency and satisfaction. These showed means of: 4.30 (SD = 0.36), 4.35 (SD = 0.34), 4.42 (SD = 0.45) and 4.49 (SD = 0.47), respectively (Table 4). The overall quality of the system design was estimated as good and the degree of clarity of system was rated higher than target levels.

CONCLUSION

In this study, the researchers have offered a framework and system for the online participatory digital talking book (DAISY) production system (OPDAISYS). OPDAISYS is an innovative process for automatically generating DAISY digital talking books within a social

framework of participation. The implementation of OPDAISYS involved several steps including a consideration of various aspects of information and knowledge sharing systems for the print disabled, conceptual development, human-computer interface design and evaluation of the overall quality of the system environment.

In particular, the system aims to increase the number of DAISY talking books and decrease the cost of DAISY talking book production in Thailand. It enables the print disabled community to have greater opportunities to access information, education, facilities and technology. The service had several advantages including its speed of delivery. This is an important advantage for the print disabled who are often pressed for time in accessing information and completing their studies. Moreover, volunteers can devote time to the production of the digital books more easily.

Also, the possibility of having quick access to DTB's whole collection of books is a useful way of stimulating students to broaden their reading. The service reaches more people with print disabilities and volunteers when based at the local university library, it is easier to go to the university library than it was in the old system. The response from the expert reviewers was very positive, even though the new service also meant more work for them. They were motivated by this positive use of modern technology.

The response from the users indicated that working with the new service provided a meaningful and rewarding experience. Finally, this study evaluated the concept of an innovative procedure to automatically generate DAISY digital talking books by social participation. It was confirmed that the OPDAISYS as an online participatory digital talking book (DAISY) production system, provided useful benefits.

The System design and developing environment template may be generalized for use in other contexts that require an online supplemental environment to support participatory development. It can be further noted that there are implications for usability studies for the development of systems. From time to time, the most serious problem confronting DTB was the poor quality of a number of volunteers and talking books. OPDAISYS was a pioneer in DAISY production and the quality of talking books has increased over the years, however many older books were defective.

In addition, the volunteers can participate more easily in selecting the content, sharing voice to created DTB, improvement and sharing experiences. Those with a print disability also find it easier to access talking books. After the development of the OPDAISYS a major project was launched and completed following the objectives of the researchers. Every book in the archive has been validated and meets the specifications described in the DAISY standard. There is now an archive that exclusively contains the OPDAISYS system for valid DAISY talking books production. This makes it easier to correct books in the archive and it will be easier to upgrade the collection to new versions of DAISY in the future.

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