

AN ACCESSIBLE WEB-BASED INFORMATION BROADCASTING SYSTEM FOR BLIND PEOPLE

Hsiao Ping Lee

*Department of Applied Computer Sciences, Chung Shan Medical University, Taichung, Taiwan, R.O.C.
Department of Medical Research, Chung Shan Medical University Hospital, Taichung, Taiwan, R.O.C.*

Chien-Hsing Chen

Department of Applied Computer Sciences, Chung Shan Medical University, Taichung, Taiwan, R.O.C.

Tzu-Fang Sheu

Department of Computer Science and Communication Engineering, Providence University, Taichung, Taiwan, R.O.C.

Keywords: Accessibility for blind people, Accessible information broadcasting system, Accessible web applications, Ubiquitous information access.

Abstract: Generally, audio data is most accessible to the blind. One of the possible ways to improve the web accessibility for the blind is to provide them with the information in audio format. It is essential to develop an automatic and customized system for blind people that converts the information on the Internet to audio in real-time. In this paper, we propose a novel accessible information broadcasting system, which is specifically designed for blind people. The proposed system provides an audio-based information broadcasting service with an accessible web interface. The proposed system searches and converts the customized information on the Internet or user-specified articles to audio. Via modern text-to-speech technology, the conversion can be done automatically. By subscribing preferred subjects, blind people can access the information that they are interested in periodically without barriers. Moreover, the user interface of the proposed system is approved at A⁺ certification level under web accessibility guidelines. That is, blind people can access abundant information on the Internet on demand by using the proposed system. The proposed system approaches the goal of realizing friendly access of the Internet for blind people.

1 INTRODUCTION

The Internet is an increasingly important resource in many aspects of life: education, employment, commerce, health care, entertainment, and more. It has become one of the most important media for people to obtain information. Through the Internet, people can access interesting and real-time information. However, the accessibility for blind people is not fully considered in the design of every website. Many websites have accessibility barriers that make them difficult or impossible for blind people to access the content in the sites. It leads to unequal access and unequal opportunity to blind people.

The information in audio format might be most accessible to blind people. Audio-based information broadcasting services on the Internet might help blind people to obtain new information effectively. Inter-

net radio (Hoeg and Lauterbach, 2009; Kozamernik and Mullane, 2005) and podcasting (Harvard, 2010) are two commonly available audio-based services on the Internet. Internet radio, like traditional broadcasting media, presents users with continuous audio streams, except the audio is transmitted via the Internet. Podcasting works with RSS (Really Simple Syndication) (Winer, 2001; Winer, 2003). Unlike Internet radio, users can decide what programs they want to receive and when they want to listen to the programs in the podcasting service. In addition, any individual can create a podcast that interested listeners can subscribe to.

However, the user interfaces of some Internet radio services are too complex to be accessible to blind people. Besides, users must employ a special client software, for example podcatcher to use the podcasting service, but the accessibility for blind people is

not considered in the design of the client software. On the other hand, the Internet radio or podcasting service does not convert the information in the Internet to audio automatically. All of the content provided in the services must be pre-made by human beings. It means that if a blind person finds some interesting articles in the Internet, or moreover, want to subscribe some interesting subjects, he (or she) is unable to access the preferred articles immediately via the Internet radio or podcasting service until there is someone made the articles as podcasts or Internet radio programs. Moreover, without the assistance of sighted people, blind people can not convert specified data to audio, or share it to others via the services. The problem of requiring the assistance of sighted people for Internet information access is not completely solved by the Internet radio and podcasting services. Thus, it is essential to develop an information broadcasting system that provides equal access and equal opportunity to blind people.

In this paper, we propose an accessible information broadcasting (AIB) system for blind people. It is a web-based application. The user interface of the AIB system is approved at A⁺ certification level under Accessible Web Development Guidelines (AWDG) (RDEC, 2009). The AIB system provides an information broadcasting service that combines both audio-based and text-based content. It is a brand-new model for information access, and it is an innovative intelligent web-based service. To access the content of an article in a website, the only thing that users have to do is to specify the URL (Uniform Resource Locator) of the article. When the access request is received, the AIB system retrieves content from the article, and then converts the content to audio automatically. Both online listening and downloading for private listening are supported in the system. Moreover, the AIB system allows users to subscribe subjects that they are interested in websites. The system gets and processes the articles related to the subjects automatically and periodically. The AIB system also supports private text file conversion. All of the functions supported by the AIB system are accessible to blind users. The AIB system benefits blind people to subscribe and access the abundant information in the Internet. The implementation of the AIB system uses several popular web technology and techniques, such as RSS, XML (Extensible Markup Language) (IETF, 2001; Murata et al., 2009), SAX (Simple API for XML) (Brownell, 2002; Bodie, 2002), TTS (Text-To-Speech) (Allen et al., 1987; Santen, 1997; Dutoit, 2001), JSP (JAVA Server Pages) (Avedal et al., 2000; Murach and Steelman, 2008), and AJAX (Asynchronous JavaScript and

XML) (Ullman and Dykes, 2007; Crane et al., 2005; Zakas et al., 2006). The use of the technology and techniques make the system efficient and responsive. Furthermore, The AIB system is also able to serve persons who must read through hearing temporarily, for example drivers. The system provides users, especially blind users, with ubiquitous and accessible reading through the use of hearing anytime and anywhere, which will realize the goal of smart and independent living.

The rest of the paper is organized as follows. The implementation of the web-based accessible information broadcasting system is presented in Section 2. The functionality of the proposed system is described in Section 3. Finally, we conclude the paper in Section 4.

2 THE ACCESSIBLE INFORMATION BROADCASTING SYSTEM

The accessible information broadcasting (AIB) system is a novel web-based information system. It is designed specifically for blind people to obtain information in the Internet. The AIB system automatically converts text-based RSS articles to audio, and simultaneously provides text-based and audio-based information broadcasting services. The system also supports the conversion of private text documents, and provides downloadable audio files. To increase processing efficiency, the data mining-based analysis is adapted in the AIB system. In addition, the accessibility issues for blind people are considered in the design of system interface. Due to the implementation of the accessibility solutions, the AIB system is accessible to blind people.

The AIB system is composed mainly of five modules: RSS agent, article content parser, text-to-speech (TTS) engine, real-time photo search engine and web page generator. All of the modules are implemented in JAVA-based technology and techniques. The system architecture is presented in Figure 1.

The RSS agent is implemented in the multi-threading technique. The agent accesses remote sites periodically, and check the status of the RSS articles in the sites. If a new or updated article is found, the agent gets the latest version of the article automatically. The downloaded article is stored in an individual local file, which is in its original XML format. The file and the attributes of the file (or article), such as the path, size, category, subject and updated date, are packed into a data structure called article instance.

An article instance represents an article in a remote site. The AIB system builds a hierarchical indexing system on the article instances to increase retrieval efficiency.

The article content parser module is used to retrieve content from the article instances. Since the article content requires to be read only once and sequentially, SAX is used in the module to parse the XML codes in the article instances. Compared with the other alternative of XML parser, DOM (Document Object Model) (Garet, 2002), SAX is more efficient and less memory requirement in this case. If the article is already in text format, which might be uploaded directly from users, it is passed immediately to output without further parsing. The output of the module is in text format, and is delivered to both the TTS engine and web page generator as input.

The TTS engine module converts text data to speech in WAV or MP3 format. The downloadable audio files are prepared simultaneously. The module utilizes the multi-threading technique to achieve fast response and high throughput. The TTS engine is an implementation of Microsoft SAPI (Speech API) (Microsoft, 2010) interface, and is compatible with SAPI 5 specification. The TTS engine provides various voices in multiple languages, and all attributes, such as intensity, speed and pitch, of the voices are dynamically adjustable. A configuration file is used in the TTS engine to record the default values of the attributes of every available voice. The list of available voices and the default voice for each supported languages are also recorded in the configuration file. In addition, a sentence splitter, that splits input sentences into partitions of identical languages, is implemented in the module. The splitter ensures the overall sentence is correctly pronounced.

The real-time photo search engine module uses article instances as input. The module analyses the input, and then, based on the analysis results, searches for the photos related to the article. The content analysis is accomplished based on data mining techniques. Google APIs are used in the implementation of the module. The APIs make it more efficient to accomplish the photo search and integrate the photos into web pages. The photos, with the context, provide more information about the article for the quick understanding of the article.

The web page generator module combines the input from the article content parser, TTS engine and real-time photo search engine to generate the web page for users' requests. The module is implemented in JSP technology. The AJAX technique is also utilized in the module to achieve a fast response. In addition, a pre-fetch strategy is used in the module

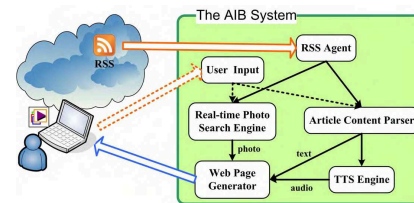


Figure 1: The architecture of the AIB system.

to fetch possible next articles beforehand. The pre-fetch processing is accomplished based on data mining analyses. The pre-fetch increases the efficiency of the module. To make the web page accessible to blind people, the accessibility issues are considered in the design of the web pages. The accessibility solutions for blind people, such as keyboard equivalents for mouse-driven commands, access keys and alternative text, are implemented in every web page produced by the module.

3 THE SYSTEM FEATURES AND FUNCTIONS

The proposed AIB system, except the TTS engine module, was implemented on a PC with one Intel Pentium 4 3.0GHz CPU, 768MB RAM and 80GB disk space. The operating system was Microsoft Windows XP home edition. The TTS engine was implemented on a PC with one Intel Core 2 Duo E6550 2.33GHz dual-core CPU, 2GB RAM and 160 disk space. The operating system was Microsoft Windows XP professional edition. All of the modules in the AIB system were implemented in JAVA language.

The AIB system provides a web interface for users to access the service. The web interface satisfies the criteria of A⁺ certification under the AWDG. The organization of the web page includes four areas: navigation, text content, photo gallery, and player functions. The home page of the AIB system is presented in Figure 2.

The navigation area provides quick access to different subjects, including news, magazines, English learning, customization and user's guide. In the news and magazine subjects, the AIB system shows the latest news and articles in different categories, where the news are retrieved from a RSS provider that system pre-defined. In the English learning page, it provides English articles in text and audio format simultaneously. Therefore, people can read and listen to the article at the same time, which helps people learning English as a second language. In the customization page, users can upload a text file or provide a RSS provider in URL, and then the AIB system will con-



Figure 2: The home page of the AIB system.

vert the preferred content into an MP3 file for download. Finally, the user's guide page describes the functions of the AIB system and the manual of this web service.

The text and photo gallery area change their content while a user selects or switches to a different article. The article's title, content and release time are all shown in the text area and the corresponding audio file. The player functions' area has five buttons to control the audio player and to switch articles in sequence, including start, stop, next article, previous article, auto-play, and download.

In order to provide an accessible and friendly interface to blind people, the AIB system applies access keys to trigger the functions of the proposed AIB web service.

4 CONCLUSIONS

In this paper, we propose an accessible information broadcasting system for blind people. It is at A⁺ certification level under the Accessible Web Development Guidelines. The proposed system automatically converts the information in the Internet to audio. It benefits blind people to access the information. By using the proposed system, blind people is able to access the information that they are interested in the Internet on demand, without relying on the assistance of sighted people. The proposed system provides a good solution, hearing the Internet, for blind people to solve the problem of Internet information access. Moreover, the proposed system provides blind people with ubiquitous access of the Internet through the use of hearing anytime and anywhere, which will realize smart and independent living for blind people.

ACKNOWLEDGEMENTS

The authors would like to thank the National Science

Council of the Republic of China, Taiwan, for financially supporting this research under Grants NSC99-2218-E-040-001.

REFERENCES

- Allen, J., Hunnicutt, M. S., Klatt, D. H., Armstrong, R. C., and Pisoni, D. B. (1987). *From text to speech: the MITalk system*. Cambridge University Press.
- Avedal, K., Ayers, D., Briggs, T., Gonchar, G., Khan, N., Henderson, P., Holden, M., Lei, A., Malks, D., Tyagi, S., Osmond, S., Siegmann, P., Damme, G. V., Wilkinson, S., Zeiger, S., Halberstadt, A., Burnham, C., Timney, J., Myers, T., and Nakhimovsky, A. (2000). *Professional JSP : Using JavaServer Pages, Servlets, EJB, JNDI, JDBC, XML, XSLT, and WML*. Wrox Press.
- Bodie, M. A. (2002). *The Book of SAX: The Simple API for XML*. No Starch Press, 1 edition.
- Brownell, D. (2002). *SAX2*. O'Reilly Media.
- Crane, D., Pascarello, E., and James, D. (2005). *Ajax in Action*. Manning Publications, 1 edition.
- Dutoit, T. (2001). *An Introduction to Text-To-Speech Synthesis*. Springer.
- Garet, P. L. H. (2002). The w3c document object model (dom). <http://www.w3.org/2002/07/26-dom-article>. Retrieved 2010-09-28.
- Harvard (2010). Podcast production. <http://isites.harvard.edu/icb/icb.do?...page23750>. Retrieved 2010-09-27.
- Hoeg, W. and Lauterbach, T. (2009). *Digital audio broadcasting: principles and applications of DAB, DAB+ and DMB*. Wiley.
- IETF (2001). Xml media types, rfc 3023. <http://tools.ietf.org/html/rfc3023#section-3.2>. Retrieved 2010-09-27.
- Kozamernik, F. and Mullane, M. (2005). An introduction to internet radio. *EBU TECHNICAL REVIEW*.
- Microsoft (2010). Microsoft speech api (sapi) 5.3. [http://msdn.microsoft.com/en-us/library/ms723627\(v=vs.85\).aspx](http://msdn.microsoft.com/en-us/library/ms723627(v=vs.85).aspx). Retrieved 2010-09-28.
- Murach, J. and Steelman, A. (2008). *Murach's Java Servlets and JSP*. Mike Murach & Associates Inc, 2 edition.
- Murata, M., Kohn, D., and Lilley, C. (2009). Internet drafts: Xml media types. *IETF Internet Draft*.
- RDEC (2009). Web guide service. <http://www.webguide.nat.gov.tw/Survey/...&mp=10>. Retrieved 2010-09-28.
- Santen, J. P. H. V. (1997). *Progress in Speech Synthesis*. Springer, 1 edition.
- Ullman, C. and Dykes, L. (2007). *Beginning Ajax*. Wrox.
- Winer, D. (2001). Rss 0.93 specification. <http://backend.userland.com/rss093>. Retrieved 2010-09-27.
- Winer, D. (2003). Rss 2.0 specification. <http://cyber.law.harvard.edu/rss/rss.html>. Retrieved 2010-09-27.
- Zakas, N. C., McPeak, J., and Fawcett, J. (2006). *Professional Ajax*. Wrox.