MathPlayer: Web-based Math Accessibility

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ABSTRACT

MathPlayer is a plug-in to Microsoft's Internet Explorer (IE) that renders MathML[11] visually. It also contains a number of features that make mathematical expressions accessible to people with print-disabilities. MathPlayer integrates with many screen readers including JAWS and Window-Eyes. MathPlayer also works with a number of TextHELP!'s learning disabilities products.

Categories and Subject Descriptors

H.5.4 [**Information Systems**]: Information Interfaces and Presentation—*User Issues*.

General Terms

Design, Human Factors.

Keywords

Print Disabilities, Visual Impairments, Math Accessibility, Assistive Technology, MathML

1. INTRODUCTION

Access to mathematical content by those with print-related disabilities (blindness, low-vision, and certain learning disabilities such as dyslexia) is limited. A number of projects have focused on math accessibility.

Early work includes MathTalk[12], MAVIS[3], AsTeR[10], and TRIANGLE[2]. MathTalk was envisioned as a standalone product as was MAVIS, although MAVIS's Nemeth Code[8] braille translation was integrated with Scientific Notebook[5]. AsTeR is built on top of EMACS and reads LaTeX documents. TRIANGLE use a notation that is similar to TeX, but with special characters replacing TeX's math commands.

More recent work has involved MathML. MathML is the World Wide Web Consortium's (W3C) recommendation for including math in XML and most mathematical software supports importing and/or exporting MathML. MathML not only enables visual display of mathematical expressions, it can be used for computation or translated into speech or into one of the many math braille codes. Two larger projects that involve MathML are UMA[4] and Lambda[9]. Both projects have a strong focus on two-way translation between MathML and multiple braille math codes. They also include some standalone software for voicing and navigating math.

Our work differs from previous work mainly in its focus – MathPlayer is a mainstream application that is also designed to work with popular assistive technology (AT) software. Our goal is to allow people to continue to use tools that they are already familiar with such as JAWS and IE, and not require them to use a different browser simply because the document they are reading contains mathematical expressions.

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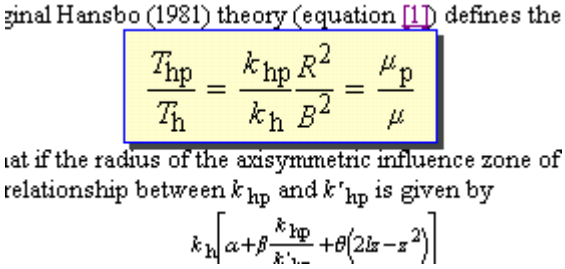
2. MATHPLAYER FEATURES

MathPlayer is a free plug-in for IE that displays MathML in Web pages. Because MathML is not an image format, MathPlayer is able to dynamically display a mathematical expression that matches the document's font properties such as size and color. Hence, if a user chooses to read a document using a larger font size than standard or chooses a particular color scheme, the math will also be displayed using that larger font size or color scheme.

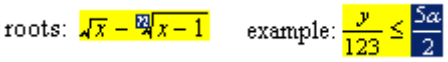
Mathematical typography uses multiple font sizes. For example, subscripts and superscripts are typically reduced in size. Because of this, some parts of an expression may not be easily readable even though MathPlayer uses a font size that matches the rest of the (easily readable) document. Rather than requiring a user to enlarge the entire document, the user can click on an expression to obtain a magnified view of that single expression. This is shown below:



MathPlayer supports speech generation and seamlessly works with many AT software products such as JAWS, Window-Eyes, and Read&Write 7. The MathPlayer interface for speech currently being used by most AT software restricts communication to simple text strings – no speech engine control strings can be used for prosody. However, two differing amounts of pauses are achieved by the judicious use of commas and periods. MathPlayer's speech interface supports SAPI4[6], SAPI5[7], and SSML[1] tagged strings and we are working with AT vendors to make use of those interfaces.

MathPlayer supports several forms of navigation, although AT vendors currently do not make use of them. At the moment, because screen readers use an off-screen model, users can only navigate through the spoken verbal description of the math; no structural navigation is possible. We are working with several vendors to determine the best interface for their needs so that MathPlayer's other modes of navigation are available to users.

Synchronized highlighting of text with speech is a feature of many high-end screen magnifiers and learning disability tools. It seems very likely that synchronized highlighting of math and speech is useful and so this feature was added to MathPlayer. TextHELP's BrowseAloud incorporates MathPlayer's synchronized highlighting. MathPlayer's synchronized highlighting is very flexible. The foreground and background colors can be changed, as can the granularity of synchronization as is shown below:



Finally, MathPlayer allows users to copy a MathML expression so that it can be pasted into any MathML-aware program. This is particularly useful for computation, but might also be useful when used in conjunction with other software aimed at making math accessible.

MathPlayer 2.0, which includes integrated speech with AT software, was released in the spring of 2004. It is available for free download from www.dessci.com.

3. FUTURE WORK

MathPlayer's speech rules are currently built-in. We plan to let them be customized so that alternate speech rules and rules for foreign languages can be used. The work is complicated by a need to support synchronized highlighting with the speech and the need to allow specification of prosodic information as part of the rules.

Braille translation is not currently a part of MathPlayer. We plan to define an API so that we can call third-party translators when a document is being sent to an embosser.

MathPlayer currently works only in Internet Explorer. Two other common formats for distributing documents are Microsoft Word and PDF. We are investigating methods to make mathematical expressions in those formats accessible also. For Word and other Microsoft Office products, this can be done by making use of MathType's ability to translate most math expressions used in Word into MathML. Once in MathML, we can leverage the work done for MathPlayer in IE to speak, synchronize, and navigate the expression. For PDF, we are working with AIIM's effort to define a Universal Access PDF document format standard (PDF/UA) that includes math. MathML will be embedded in a PDF document so that an Adobe Reader plug-in can access the MathML corresponding to a math expression and speak it, navigate it, and highlight it.

4. ACKNOWLEDGMENTS

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5. REFERENCES

[1] Burnett, D.C., Walker, M.R. and Hunt, A. Speech Synthesis Markup Language (SSML) Version 1.0, 2004, http://www.w3.org/TR/speech-synthesis/.

[2] Gardner, J., Stewart, R., Francioni, J. and Smith, A., TIGER, AGC, AND WIN-TRIANGLE, REMOVING THE BARRIER TO SEM EDUCATION. in *CSUN International Conference on Technology and Persons with Disabilities*, (Los Angeles, CA, 2002).

[3] Karshmer, A.I., Gupta, G., Geiiger, S. and Weaver, C. Reading and writing mathematics: the MAVIS project in *Proceedings of the third international ACM conference on Assistive technologies* ACM Press, Marina del Rey, California, United States 1998 136-143

[4] Karshmer, A.I., Gupta, G., Pontelli, E., Miesenberger, K., Ammalai, N., Gopal, D., Batusic, M., Stöger, B., Palmer, B. and Guo, H.-F. UMA: a system for universal mathematics accessibility. in *Proceedings of the ACM SIGACCESS conference on Computers and accessibility*, ACM Press, Atlanta, GA, USA, 2004, 55-62.

[5] MacKichan Software. Scientific Notebook, www.mackichan.com.

[6] Microsoft. Speech API 4.0 SDK Documentation, http://www.microsoft.com/speech/download/old/sdk40a.asp.

[7] Microsoft. Speech API 5.1 SDK Documentation, http://www.microsoft.com/speech/download/sdk51/.

[8] Nemeth, A. *The Nemeth Braille Code for Mathematics and Science Notation*. American Printing House for the Blind, Frankfort, 1972.

[9] Nicotra, G. and others. Lambda Project, http://www.lambdaproject.org.

[10] Raman, T.V. *Audio System for Technical Readings*. Cornell University, 1994.

[11] Ron Ausbrooks, S.B., David Carlisle, Stéphane Dalmas, Stan Devitt, Angel Diaz, Max Froumentin, Roger Hunter, Patrick Ion, Michael Kohlhase, Robert Miner, Nico Poppelier, Bruce Smith, Neil Soiffer, Robert Sutor, Stephen Watt. Mathematical Markup Language (MathML) Version 2.0 (Second Edition), 2003, http://www.w3.org/TR/2003/REC-MathML2-20031021/.

[12] Stevens, R.D., Edwards, A.D.N. and Harling, P.A. Access to mathematics for visually disabled students through multi-modal interaction. *Human-Computer Interaction (Special issue on Multimodal Interfaces)*. 47-92.