Non-Visual Access to Non-Textual Information through DotsPlus and Accessible VRML

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Abstract

Non-visual access to non-textual information presents many challenges. One challenge is that there are many examples of information in which the content and visual layout are almost inextricably tied together. When a clear separation of content and presentation is possible, a second challenge arises - there are few electronic formats that actually make this separation. A final challenge is that of finding efficient, intuitive, inexpensive methods of displaying nontextual information nonvisually. Two research programs at Oregon State University that address some of these challenges are described in this paper. One is the development of the DotsPlus tactile font set and TIGER (TactIle Graphics EmbosseR). The second is use of VRML to produce audio/tactually accessible 2D figures.

Keywords:

DotsPlus, tactile graphics embosser, VRML nontextual information, print disabilities

Introduction

Speech or braille screen readers can provide excellent access to standard computerized text (although access can be severely hindered by complex electronic formats such as the PDF information provided for potential presenters at this conference). Very little other computerized information can be accessed easily (Barry 1994).

This paper discusses briefly two nontextual information access research projects underway at Oregon State University. Each is an attempt to find a general solution by defining or extending current paradigms for display or data storage.

DotsPlus

DotsPlus is a paradigm for representing text tactually in one of several fonts. Each character is unique and recognizable out of context. These characteristics permit DotsPlus to be used in graphics applications where text may appear in unpredictable locations. Examples include mathematical equations, and labels or other text notations on diagrams, maps, charts, etc.

The original DotsPlus font represented letters in 8-dot braille (Gardner 1993) Subsequently a number of improvements were made, in particular to the original punctuation marks, and a 6-dot DotsPlus font was developed (Gardner 1998). Lower case letters are standard braille in both font sets. A number of other symbols are also represented in braille but most of the thousands of symbols appearing in specialized literature are represented by tactile images of the ink print symbol.

In 8-dot braille and DotsPlus, capital letters are indicated by a dot in the dot-7 position (left bottom dot in a cell having four rows and two columns of dots). In 6-dot braille and DotsPlus, capital letters are indicated as a double width 6-dot cell. The right side of that cell is lower case braille, and the left side is the capital letter indicator. In English braille and DotsPlus, the capital indicator is a dot in the lower right position.

DotsPlus numbers are represented by European Computer Braille, and punctuation marks are represented by graphic symbols that feel much like braille punctuation marks but are distinguishable from dropped letters if examined carefully.

We believe that most literary braille readers who want to learn DotsPlus can do so rather easily. Apart from the numbers, standard text reads very much like uncontracted braille. A DotsPlus reader of more advanced literature must learn many new symbols, but this is identical to the learning process of sighted readers. A blind or sighted child must both learn the shape of a plus and equals sign before learning to do arithmetic for example.

There are only minor differences between DotsPlus fonts among languages sharing the roman alphabet. In 8-dot DotsPlus, the period (full stop) symbol shape may be altered for languages (e.g. German, Swedish) having a different braille period from the English/French symbol. For 6-dot DotsPlus the "prefix" symbol in the double cell braille symbols can be changed to reflect different capital letter indicators used in languages other than English. Such differences are minor enough that readers should have little difficulty reading literature printed in other languages. This is unfortunately not true for most braille literature.

Widespread testing and use of DotsPlus has been severely hindered by the difficulty and expense of printing DotsPlus. A wax-jet printer used for original DotsPlus research is no longer commercially available. Swell paper can be used to make DotsPlus materials, but swell paper is expensive and requires considerable expertise to make copy in which braille dots are easy to read.

A new technology invented at Oregon State University now allows embossing with resolution good enough to make DotsPlus materials. The TIGER printer, based on this new technology, is expected to become commercially available at a cost of approximately $6000 by the time of this conference. The TIGER includes a Windows 95 printer driver that permits direct printing from most Windows 95 applications. Users need to use a screen font with the correct size and should avoid complex multicolored or gray scale drawings. Otherwise virtually anything that can be printed on a standard printer can be printed on TIGER.

Accessible Graphics using VRML

Virtual Reality Modeling Language (VRML) is becoming popular in World Wide Web applications (Roehl 1996, Carey 1997). VRML allows one to create time-dependent three-dimensional models that can be displayed interactively. VRML "figures" are electronic files organized into a well-structured tree and are displayed by viewers that provide a two dimensional projection of the model (VRML 1997). Users may interactively modify the view by turning or moving through the model.

We have taken advantage of the power and flexibility of VRML to construct and display simple two dimensional figures such as those appearing in scientific literature at all levels. (Bulatov, 1998) We construct a VRML model using any convenient three dimensional objects whose projection is the 2D picture we desire. This may be done with standard authoring tools and eventually with a special 2D authoring tool we intend to write. This model is then modified with a special editing software application we have designed. With this editing software one may produce a second VRML file in which each object can be provided with a label that contains information that is, in principle, arbitrarily rich. Presently we permit only plain text.

Standard VRML browsers display the second file identically to the first. However if the model is well structured, and the labels are sufficiently informative, the second VRML figure is completely accessible to people with print disabilities through one of a number of specialized "viewers".

The special viewers are programs that supplement a standard VRML viewer by interpreting the special labels. The simplest special viewer, and the only one that is near completion at present, uses a common technique that permits a blind user to "read" a complex tactile figure with the help of a computer. A tactile copy of the VRML picture must be made and placed on an external digitizing pad. A blind user may then explore the tactile figure and request information about objects. This request, made for example by pressing on an object and activating the digitizing pad, causes the label to be displayed on the computer screen and, if desired, browsed in audio through use of an internal speech engine. In principle the label can be read with a braille or speech screen reader also.

The "audio/tactile" viewer has the disadvantage that a tactile copy must be printed before the figure can be read. An external digitizing pad is also required. Many kinds of information can be displayed by simpler schemes in which some kind of on-line tactile or audio object locator gives the user qualitative or semi-quantitative information about the position and shape of objects in the model. Then the user can choose to display the label for more information. We note that a three-dimensional object locator that a blind user can use to follow an object would open the possibility of access to nearly any VRML model, not just 2D projections. Finally, there are classes of information (e.g. structured trees, flow diagrams, charts, and tables) for which a user may find it more convenient to explore logical structure rather than physical structure.

These are all possible in principle, but a considerable amount of research and testing is required to learn how to translate these concepts into useful products. The special accessible VRML format we have developed permits this type of research.

The purpose of this research project is to make 2D graphics accessible to people with print impairments, not specifically to make VRML accessible. However VRML is presently the only public format that is both well-structured and flexible enough to permit addition of labels. VRML models of the future could, in principle, be made fully accessible by the authors if they choose to add sufficiently detailed labels. Alternatively, it is relatively straightforward for an editor later to add labels to a well-designed existing VRML model. To our knowledge no other 2D or 3D graphics format permits either possibility. These two properties, along with the existence of a number of user-specific special viewers make the VRML format potentially quite accessible.

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Biographical sketch:

John Gardner directs research programs in both Materials Physics and Information Access technologies. The latter was undertaken after losing his sight in 1988. His research is funded by the US Department of Energy and the National Science Foundation. He has won a number of prizes for excellence in both research fields.