The AirBook:
force-free interaction with dynamic text in an assistive reading device

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ABSTRACT
We describe a prototype of the AirBook, an assistive reading device that combines dynamic text (especially RSVP, that is, rapid serial visual presentation) with force-free capacitive field sensors to create a simple, easily controlled assistive reading device. This reader is designed to assist people with visual disabilities (like dyslexia, loss of fine motor control or loss of contrast sensitivity) by giving them more control over font size and contrast. It's also for people with upper-body disabilities, lack of fine muscle control, or severe arthritis, all of which can make the reading of standard paper books difficult. The force-free sensor system can be adjusted for large-scale motion or for tiny ranges of movement, and requires no pressure or fiddling with physical objects. The sensors read the proximity of a human limb, and adjust parameters on the text accordingly. For example, the reading device can be controlled with the motion of one finger if necessary, or adjusted to read the motion of an entire arm or leg.

Keywords
Dynamic text, kinetic text, assisted reading, speed reading, interaction design, RSVP, interaction metaphors , navigation, capacitive field sensors, force-free interaction.

INTRODUCTION
Our work explores new ways of experiencing text: new genres, new styles of interaction, and unusual media. One such project was the design of a set of reading instruments for an exhibit at the San Jose Tech Museum of Innovation entitled "XFR: Experiments in the Future of Reading." [1] Our goal for the XFR exhibit, which drew over 250,000 visitors in six months, was to associate a sense of excitement, fun, and personal control with reading.

Visitor responses to the exhibit often focused on possible assistive uses of these new technologies and led us to explore the design of an assitistive reading instrument The AirBook is an adaptation of a device called *Speeder Reader* which was part of the XFR exhibit. The AirBook emphasizes personal control; it is built upon the idea that both text and the device that is used to read it should be designed for the convenience of the reader, not constrained by issues like limited page space (which leads to small fonts) or the necessity to hold a book and turn its pages (which some people find difficult).

Many assisted reading devices and systems already exist. [2] Some focus on text-to-speech systems, some are elaborate robotic devices for manipulating real books, and others are software display systems. However, we found none that combine ease of physical control with adjustments for visual compatibility in the way that the AirBook does. Simplicity and relatively low cost are other attractive factors in this design.

Description
The AirBook consists of a computer, a monitor and a tabletop interface which is two leather-covered sensor electrode plates (copper foil plates about four inches square), mounted at a comfortable angle (about 30 degrees). The plates are connected to capacitive field sensors, which can track the proximity of anything conductive, including human hands and fingers. Although in this prototype the plates are surface-mounted to a table, they can also be mobile pads or small boxes that can be placed wherever is most convenient.

A reader sits at a table and controls the text as it appears on AirBook's computer screen by sliding her arms or hands along the stable table-mounted surface, until a comfortable reading speed is reached. Then no more motion is required, until the reader has finished. The range of motion and degree of control required is adjustable for the needs of

each individual. Content can be anything that is parsable into XML format, including books, papers, or the Web.

Dynamic text for assistive systems

People read printed words on a page in "saccadic jumps," a series of somewhat erratic eye motions around a page. Saccadic jumps enable people to read in a conventional left to right, top to bottom sweep [5]. Those who cannot make saccadic jumps properly often experience difficulty reading. RSVP (rapid serial visual presentation) is a kind of dynamic typography where words or short phrases appear in sequence, centered on a screen. As the words continually flash in one spot, the reader does not have to move his or her eyes, thus minimizing the saccadic jumps and eliminating the time needed to move and refocus the eyes on standard printed materials. With this protocol people have been known to increase their reading speed up to 2000 words per minute (an average proficient reader can read about 400-600 words per minute). RSVP was investigated in the 1980s as a presentation protocol for text [3] and has been used in several products as a speed reading technology. Neurologists and perceptual psychologists among others have used it as a research tool [4, 5]. Appropriate typographical and color choices also aid in comprehension and speed.

Fig. 1. The AirBook. Sketch of table model. Sensors can also be mobile pads for placing on chair arms, beds, etc.

Navigation and control with force-free sensors

One problem with RSVP text is how to browse it. How does one find different sections of content, play them at an appropriate speed, and replay them at will? In the AirBook (Fig. 1) the RSVP text is visible in a 3" by 12" rectangular window onscreen; a system control window is visible below it. The physical interface provides two force-free sensor plates, which read simple proximity achieved by sliding one's hand along a tabletop (or waving it above the sensor in mid-air; hence "AirBook"). Thus, readers can control various system parameters or navigate to different streams of text by moving their hands, which are supported by the tabletop. One sensor gives the user control over the speed of the text being displayed. The other sensor allows a higher-level set of choices, such as moving the window to a different "lane" of text, in a sideways motion. This control sensor offers the following parameters: text selection; skipping backwards or forwards to specific points in the text; starting over from the beginning; or setting a bookmark. A reader can also adjust font size, style, and color contrast with this control.

Technology

Force-free sensors are sensors that do not require physical manipulation. In this application we use capacitive field sensors from Quantum Research Labs, the QT110. [6] The sensor measures conductivity within a field. Placing a hand in the sensor's electromagnetic fields will shunt some of the current to ground. The sensor detects the current drop, and tracks the hand as it passes through the field, which provides a good real-time set of data that mirrors a user's activity. These sensors are connected to an A/D converter which communicates with the host computer via serial line. A Java 2.0 program reads the serial information and converts it to actions in the program, thus affecting the text in response to user input. We use XML not only to specify the text, but also its layout and typographical qualities. Size, color, font, and background color of the text is determined in XML and is authored along with the content of each lane of text. The text content of the control panel is also specified via XML.

Future work

The assistive technological applications for both force-free sensors and dynamic text cover a wide range of disabilities. For each particular class of disabilities, the AirBook's interface can be customized. We plan user studies and further iteration of the interface design.

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REFERENCES

1. Back, M., Gold, R., et al. "Designing Innovative Reading Experiences for a Museum Exhibition." IEEE Computer, Vol. 34, No. 1, Jan. 2001, 1 – 8.
2. Funk, K., and Pontillo, A., "Electronic Books and Text Materials for Persons with Disabilities" http://www.dinf.org/csun_98/csun98_131.htm
3. Potter, M. "Rapid serial visual presentation (RSVP): a method for studying language processing." Kieras and M. Just, New methods in reading comprehension research. Erlbaum, Hillsboro, NJ, 1984.
4. Rayner K: "Eye movements in reading and information processing." Psychological Bulletin 85:618-660, 1978.
5. Wong, Y. Y. Temporal typography. characterization of time-varying typographic forms. Master's Thesis, MIT Media Lab, 1995.
6. Quantum Research Group. White paper on proximity sensors. http://www.qprox.com/whatis.htm