User Interface of a Nonvisual Table Navigation Method

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ABSTRACT
It is fervently hoped that the World Wide Web will become a new information resource for the blind. However, although the use of tables on the Web has been increasing, the currently available talking Web browsers basically read tables horizontally, making it very hard for blind users to understand them. We therefore propose a method that allows users to navigate through a table both horizontally and vertically. Our method is characterized by three features: a table cursor, a table pointer, and a cell-jumping key. In this paper, we describe the user interface of our method, report the results of our evaluation tests, and offer some conclusions.

Keywords
nonvisual, Web, blind, talking browser, table

INTRODUCTION
It is fervently hoped that the Web will become a new information resource for the blind, and various talking Web browsers have been developed [2,3] to facilitate the realization of this dream. These days, Web pages contain a lot of two-dimensional information such as tables. However, it is very difficult for talking Web browsers to represent two-dimensional information solely in the form of voice output, which is a one-dimensional medium.

We began our study by surveying the current status of table navigation. As a result, we found that existing systems provide basically horizontal table-reading methods, and that navigating through tables in this way takes a considerable amount of time. We therefore propose a new method that allows users to navigate through a table both horizontally and vertically. Our method is characterized by three features--a table cursor, a table pointer, and a cell-jumping key--that make tables more accessible to blind users.

In this paper, we first introduce the current methods of accessing tables, and then describe the user interface of our table navigation method. After reporting the results of our evaluation tests and offering some conclusions, we discuss our plans for the future.

CURRENT METHOD OF TABLE NAVIGATION
Existing talking Web browsers basically read tables horizontally, cell by cell. If a user wants to find the information below a certain cell, he must first determine which column it is in, and after moving the cursor to the next row, he has to locate the column by counting for himself. This reading method is useful only for gridded tables. (We define a gridded table as one in which all the cells are filled by basic cells. We also define a basic cell as one formed by a <TD> or <TH> tag in HTML without the use of either a COLSPAN or a ROWSPAN attribute.) When a table is ungridded, it is hard for a user to navigate through it solely on the basis of horizontal movement. One talking browser incorporates a function for limited vertical navigation. However, we consider it essential to develop a better method for navigating tables.

OVERVIEW OF OUR TABLE NAVIGATION METHOD
Our proposed method for navigating tables is implemented in our nonvisual Web access system [1]. This system uses a text-to-speech engine [4] and a numeric keypad. Our method is characterized by three features: a table cursor, a table pointer, and a cell-jumping key. When a user comes across a table while reading a Web page he can change the reading mode to the table navigation mode, and the system will create an off-screen table by analyzing the HTML tags. At this time, an ungridded table is converted into a gridded table. Figure 1 becomes figure 2 in the off-screen table. A user can navigate through this off-screen table by using the following three features:

Size	S	M		L
	4	5	6	7
Height	39	42	45	49
Chest	23	23.5	24.5	25.5
Waist	21	21.5	22	22.5

Figure 1: Sample of an ungridded table

Size (1/2R)	S	M (1/2C)	M (2/2C)	L
Size (2/2R)	4	5	6	7
Height	39	42	45	49
Chest	23	23.5	24.5	25.5
Waist	21	21.5	22	22.5

Figure 2: Sample of an off-screen table in figure 1

Table Cursor
The table cursor can be moved horizontally by pressing 4 or 6, and vertically by pressing 2 or 8 (see figure 3).

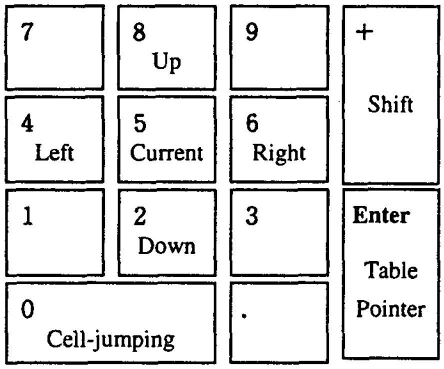

Figure 3: Key functions of the numeric keypad

In figure 2, "M" consists of two basic cells, so when the table cursor is in the first cell of "M," the system will announce "M, consisting of two columns." The system reads the message part in a female voice to distinguish between the contents and messages. If 6 is then pressed, it will read out "M, second column" in a female voice. If the user then presses 2, the table cursor is moved down and the content of the cell below, "6," is read out.

In addition to these keys for sequential cursor movements, the system provides keys for jumping to the top, bottom, leftmost, and rightmost cells in line with the current position by pressing 2, 4, 6, or 8 followed by the plus key.

Table Pointer

The difference between a table cursor and a table pointer is that the current position is changed by the table cursor, but not by the table pointer. The table pointer is provided to read out the contents of the cells surrounding the current position.

The contents of the top cell in line with the current position are read out when the user holds down the enter key and presses 8. In the case of figure 2, when the current position is "24.5", "M, second column" is read out. When the user presses 2 without releasing the enter key, the system reads out the contents of the cell below, "6." The contents of the leftmost cell in line with the current position--in this case, "chest"--are read out in a similar way.

Cell-jumping Key

One cell of an ungridded table may consist of several basic cells. A cell-jumping key is provided to allow the user to jump to the first cell of each combination of basic cells. In the case of figure 2, the user can easily find out that the first row has 4 columns, even it consists of 5 basic cells.

The cursor or pointer can be made to jump leftward, rightward, upward, or downward. The direction of jumping depends on the previously pressed key: if the "4" key was pressed last, for example, then pressing the cell-jumping key will cause the cursor or pointer to jump to the left. In this way, complicated tables such as lists of TV programs can be easily navigated.

EVALUATION

Three blind users were presented with three tasks, in order to evaluate our method in comparison with the current method based on horizontal movement (see table 1). Summaries of the tables used and a description of the best way to navigate each task were given to the users.

Task 1: Find the type of CPU used in a certain computer model.

Task 2: Find the opening time of a certain amusement park.

Task 3: Find the noontime program of a certain broadcasting station.

The subjects successfully completed all the tasks in a relatively short time by using our new method. Task 3 involved an ungridded table with a very complicated structure. Although the subjects were unable to navigate successfully by the current method, they could do so easily by our new method. One user commented that he normally tries to avoid tables when using the current method, but that they no longer interfere with his Web access in the new method. Through this experiment, we found that if blind users can navigate freely through tables both horizontally and vertically, tables can be accessible and useful to them.

Table 1: Results of evaluation tests (seconds)

	Task 1	Task 2	Task 3
Current	29	32	139 (incorrect answer)
New	16	16	55

CONCLUSION

After describing how hard nonvisual table navigation is, we proposed a new method for navigating freely through tables both horizontally and vertically. We then described the user interface of our table navigation method. Our evaluation tests showed that a table which is effective as a visual representation can also be accessible and useful to the blind.

Our final goal in this connection is to provide table summaries that present users with descriptions of what tables look like. The content of such a summary would be very similar to the explanation of a table a sighted volunteer might give to a blind person.

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