Mobile Reacher Interface for Intuitive Information Navigation

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Abstract. We propose Mobile Reacher Interface (MoRIn) that is a new interface with a visual tag for a mobile device. MoRIn allows users to navigate sophisticated information structures by making natural hand gestures while holding a camera-equipped mobile terminal. The structure of an item of interest is acquired via a visual tag. The user can then navigate the structure as if he/she is handling physical objects. MoRIn greatly eases the user's cognitive loads. For instance, the user can alter the volume of an announcement by twisting terminal as if he/she were turning a dial. We describe MoRIn, some applications, and the results of a preliminary experiment.

1 Introduction

Many new services are being created that utilize the user's mobile device as a display system. The user sees public media and acquires a visual tag which loads a URL into the terminal which then accesses the corresponding information source[1,2].

Early services provided just a simple link to go to an advertisement but more sophisticated variants are emerging. The current information structure of tag-based services is a simple pointer which brings the typical menu list. That is, the real world is not linked directly to the cyber world and the user is forced to turn away from the real world and remember the control operations needed to access the information in the menu list, see Fig.1-(a). This poses a problem since most terminals provide non-intuitive interaction devices such as buttons. A more effective interface is needed.

We believe that this unduly restricts the services available and prevents widespread adoption. Our approach is to replace the pointer with three structures that mirror the real world: the line, surface, and space, see Fig.1-(b). User can intuitively navigate the information structure which is indicated by the visual tag as if directly manipulating a real world object with a "Mobile Reacher".

To implement MoRIn, we utilize the terminal's camera to acquire the visual tag and use the physical movements of the terminal as user input to navigate the information structure indicated by the tag. The extraction of physical movement from visual field processing with the tags has already been reported; six Degrees

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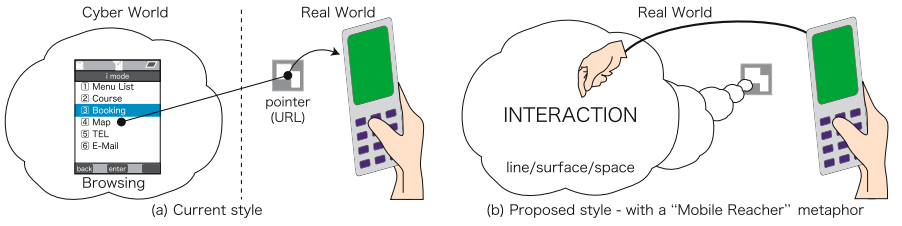

Fig. 1. Current and proposed style

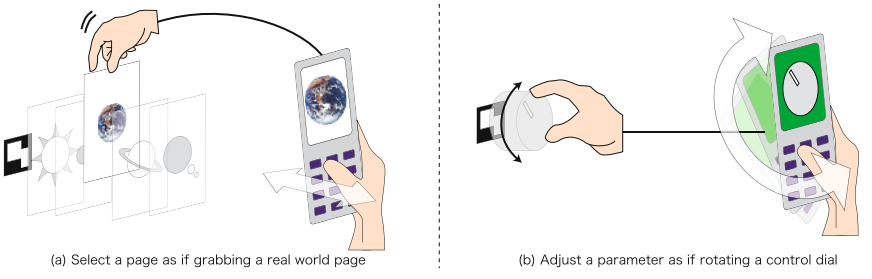

Fig. 2. Example of MoRIn

Of Freedom (DOF) are available. For instance, the research has examined the impact of overlaying the camera image with the information acquired through the tag[3,4].

MoRIn permits a wide range of intuitive operations. For instance, the user can select one of several "pages" as if grabbing a real world page, see Fig.2-(a). Fig.2-(b) shows another example, the user can adjust a parameter, such as audio volume, by rotating the terminal as if rotating a control dial. MoRIn allows users to control virtual attributes with real world actions.

We constructed a prototype MoRIn system and evaluated its performance. In this paper, we describe MoRIn, several applications, and the results of a preliminary evaluation.

2 MoRIn - Mobile Reacher Interface

2.1 Basic Operations

A MoRIn system consists of mobile devices with digital cameras, content servers, and public media, like a poster, magazine, large screen, holding the visual tags. Each visual tag is structured to provide content ID and operation ID. The operations reflect the six DOF as shown in Fig.3. Besides, the more complex operations can be composed of these basic operations.

2.2 Applications

MoRIn services consist of three layers: (1)content layer, (2)logical operation layer, and (3) operation layer. Two typical MoRIn services are shown in Fig.4.

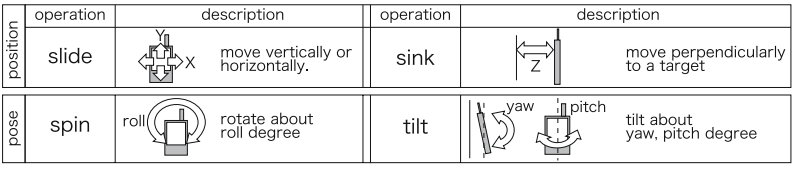

Fig. 3. Basic operations

Restaurant Map. The restaurant map shows the physical locations of the restaurants and their visual tags. Each tag calls up and displays the dishes, ordered by price, offered by that restaurant. The logical operation provided, sink, allows the user to flip through the dishes by changing the desired price. The user can lower (raise) the desired price by moving the terminal towards (away from) the tag, see Fig.4-(a).

Automatic Dis-paper(dispenser). MoRIn allows a poster to become an automatic dis-paper through the metaphor of the automatic dispenser. The poster shows several CD jacket pictures and their corresponding visual tag. The contents layer holds songs. The logical operation layer allows the user to select a song, adjust volume, and purchase a song. The user can select an album by horizontal slide, select a song by sink, adjust volume by spin, and buy a song by vertical slide as shown in Fig.4-(b).

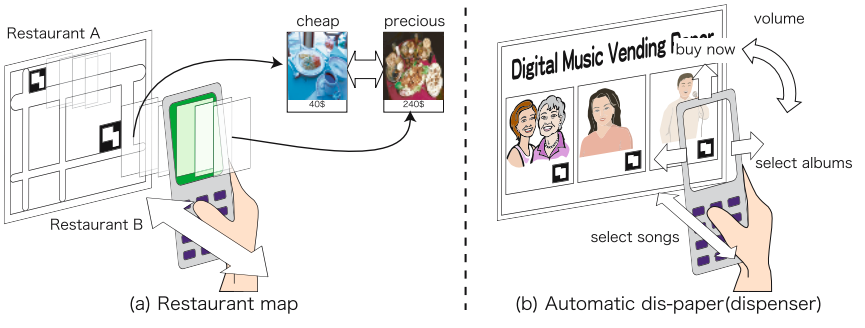

Fig. 4. Example of applications

3 Prototype System

We constructed a prototype terminal that is as small as the current cellular phones and used it to evaluate the performance of MoRIn (Fig.5-(a)). The prototype terminal was connected to a PC by a cable in order to process MoRIn software operation. Fig.5-(b) shows the flowchart of MoRIn software operation; QR Code was used as the visual tag[2].

4 Experiments and Results

We asked 3 adult subjects with no previous experience of MoRIn to use the prototype terminal to find virtual pages via visual tags as described below. The

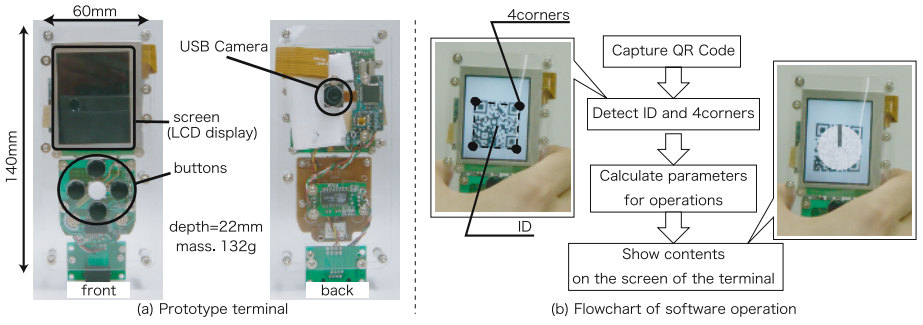

Fig. 5. Prototype system

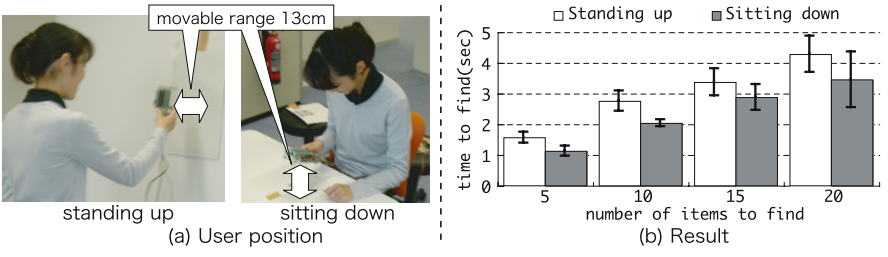

Fig. 6. Result of experiments

tags yielded information structures that consisted of 5, 10, 15, and 20 pages arranged as a vertical stack; the only operation provided was sink. The visual tags were placed on a wall and on a desk so user's position was either standing up or sitting down. For each tag in each position, the subjects were shown a number on the screen of the prototype and then told to "find the page that shows the same number." In each trial the pages were randomly ordered. Each subject repeated this action 10 times and we measured the time it took for the subjects to find the correct page. Figure 6-(a) shows the appearance of the trials and Fig.6-(b) shows the mean time taken, the bars in the figure show the standard deviation.

The results show that the subjects could page through the information structures with 10 and 15 pages in approximately 3 seconds in both positions. Two subjects commented that MoRIn could be used in the real world. We note that system performance may be degraded if the camera (currently at the center of the terminal) is placed off-center.

5 Conclusion and Future Work

We proposed MoRIn that was a new interface with a visual tag for mobile devices. MoRIn allows users to employ intuitive hand movements to navigate complex information structures and retrieve digital content. We described examples of MoRIn applications, and a preliminary evaluation of the performance of sink us-

ing a prototype system. The results confirm that visual tags, printed on posters and magazines, can realize the MoRIn service. We intend to evaluate the performance of other basic operations, and the performance of practical applications of MoRIn.

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