Tracking the Position of a Mobile Device on Interactive Screens with RFID

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1. Introduction

Recently, in the field of table-top interfaces and tangible interfaces, it has been widely attempted to develop a method of identifying and tracking the position of small objects such as pucks, tags, cellular phones, and mp3 players on interactive screens in order to enrich user interactions.

Computer vision and IR sensor techniques have been mainly employed in order to implement the object tracking on an interactive screen. However, they have several drawbacks as follows [Wilson and Sarin 2007]. IR sensor-based method can be affected by ambient light, any unexpected objects, and users' hands that unintentionally block the sensors. With the computer vision approach, cameras installed inside the system makes it difficult to build the system small. In addition, vision-based techniques generally require computationally-intensive image processing jobs.

We propose a novel method that has the following features: i) no restrictions on the size of system, ii) robustness to unexpected user behaviors and external conditions.

2. Technique

Our method uses RFID technology for identifying and tracking mobile devices. In previous researches on RFID-based methods, RFID readers are placed on the backside of an interactive screen and RFID tags are attached on objects which need to be identified. For instance, in ePro system developed by Sugimoto et al. [2006] RFID readers are embedded inside the board in a grid pattern and those readers recognize an object placed on the system. This type of technique has a drawback that its cost and complexity are relatively high because the number of RFID readers needed increases proportionally to the size of the screen.

We take the opposite approach: RFID tags are embedded in a screen and mobile devices have RFID readers. Mobile devices participate with the process of identification in cooperation with the interactive screen. Since it is much more straightforward and inexpensive to use a number of tags than to use many readers, it can be implemented independently of the screen size and advantageous in terms of simplicity and cost. In addition, our method coincides with the current trend of embedding RFID readers in mobile devices such as PDA and cellular phones for new mobile services.

Figure 1 illustrates the configuration of the proposed system. RFID tags which are attached on the backside of the screen include information on a network address of the display controller and a position of each tag. Once a user brings a mobile device close to the screen, RFID reader activates the closest tag and read data from it. Then, the mobile device connects and sends mobile device ID and tag ID to the interactive screen, which calculates the position of the mobile device. Additionally, interpolating the position using not only the closest tag but also ones in the vicinity can improve the accuracy.

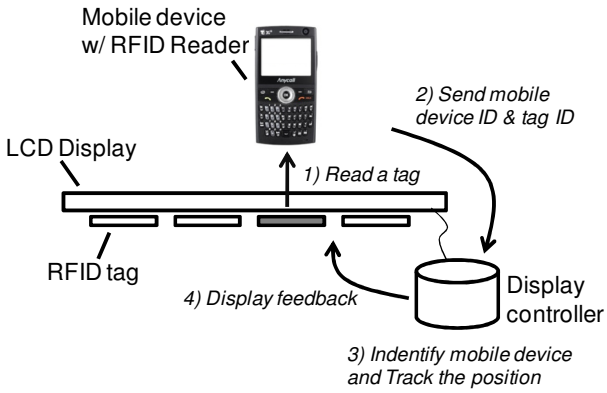

Figure 1. System configuration.

3. Prototype System

A prototype system is implemented to show the practical viability of our method. A tablet PC with 12-inch LCD screen is used as the interactive screen. 16 RFID tags, arranged in a 4x4 grid, are attached on the back side of the screen. A PDA with a CF-type RFID reader serves as the mobile device and communicates with the tablet PC via Wifi. Figure 2 demonstrates our prototype system in use.

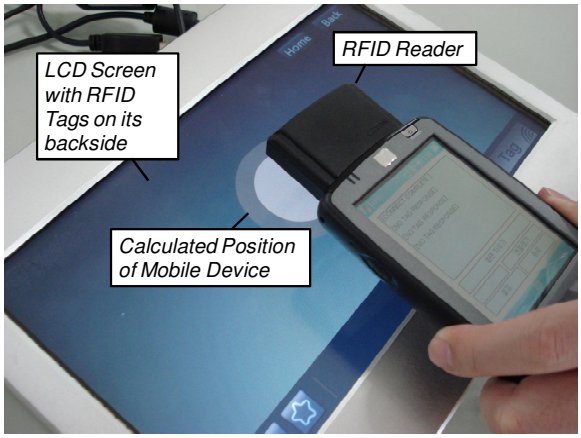

Figure 2. Prototype system in use

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