Multiple Pointing Method with Smartphone Gyro Sensor

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ABSTRACT

This paper proposes a pointing method named the Bring Your Own Pointer (BYOP). The BYOP enables an additional participation in a shared display collaboration and allows the users to point at the display simultaneously by using their own smartphones. A sticker application is developed to demonstrate the BYOP.

CCS CONCEPTS

• **Human-centered computing** → **Pointing devices**;

KEYWORDS

pointing, smartphone, gyro sensor

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1 INTRODUCTION

In a presentation on a large screen, individual audiences sometimes want to point out different positions of the screen to designate his/her concern. A laser pointer can be used by an individual for pointing; however, it is impractical to expect each audience to carry it. Pan *et al.* proposed a single-user pointing system that uses a smartphone gyro sensor[1]. We extended this system to enable multiple users to point at the screen in an ad-hoc manner. Our proposed system, the Bring Your Own Pointer (BYOP) allows users to participate in or move to a presentation whenever they like.

2 DEVELOPMENT

The BYOP system consists of a smartphone, a server created using Node.js, a display-side application created using Java, and a smartphone-side application created using HTML 5 and JavaScript, both of which are standardized technologies supported by all smartphones. Both the smartphone and the display-side applications can connect as clients to the server. In the display-side application, users can stick a digital memo at an arbitrary position in the presentation (see Figure 1). The pointer coordinates are determined by linearly transforming the value obtained from the smartphone gyro sensor and two reference points registered in advance. The transforming formula is as follows.

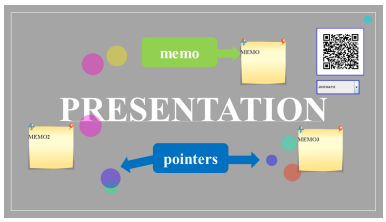

Figure 1: BYOP Presentation system

$$x = w_2 + (w_1 - w_2) \times ((\alpha - \alpha_1)/(\alpha_2 - \alpha_1))$$
$$y = h_1 + (h_2 - h_1) \times ((\beta - \beta_1)/(\beta_2 - \beta_1))$$

In this formula, (x, y) denote the positions to be pointed on the screen; α and β are the current smartphones rotation angle; (w_1, h_1) and (w_2, h_2) denote the positions of the upper left and the bottom right of the display respectively; $\{\alpha_1, \alpha_2\}$ and $\{\beta_1, \beta_2\}$ are the α and β values at the first and second points. The operating procedure of the BYOP system is as follows.

(1) Connect the server and the display-side application.
(2) Read a QR code using the smartphone at any timing. The QR code is provided beforehand to participate in BYOP.
(3) Point the smartphone to the upper right and lower left of the display and tap the screen each time to register the two reference points.
(4) Point the smartphone as desired by the user.

To confirm the ease of pointing at an intended region, we conducted an experiment that measured the time taken to click on circles with radii of 20, 50, and 100px on a $800px \times 800px$ screen. There were 10 targets for each radius. The times improved greatly as the target became larger. When the radius was 20px, the average time was 2275.5ms (the fastest was 1514.4, the slowest was 3872.6); when it was 50px, the time was 1421.7ms (1005.2, 2119.3, ibid); and it was 100px, the time was 1073.8ms (838.4, 1511.4, ibid). Given that the participants were using the BYOP system for the first time, the results suggest that this system is useful for pointing at the screen. As an example of how to use the BYOP system, we also developed a system in which users can manipulate the pointer and paste and send memos on the screen. Users can also change the pointer color and size depending on where the smartphone is tapped. We expect that this system can help make presentations more interactive.

REFERENCES

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