Blurry (Sticky) Finger: Proprioceptive Pointing and Selection of Distant Objects for Optical See-through based Augmented Reality

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Abstract

We demonstrate "Blurry (Sticky) Finger" in which one uses the unfocused blurred finger, sense of proprioception, to aim, point and directly select a distant object in the real world with both eyes open. We showcase two demo applications. The first illustrates the accuracy and usability of the proposed method with the target objects lying at a fixed depth on a monitor. The second is an AR based object inquiry system, a more practical application. The user aims and encircles a real 3D object whose image is captured with the eye-to-camera offset compensated. The image is searched through the data base with the result augmented on an OST display.

Keywords: AR, augmented reality, interface, pointing gesture, proprioception, hand-eye coordination.

Index Terms: H.5.1 [Information Interfaces and Presentation]: Multimedia Information Systems—Artificial, Augmented, and Virtual Realities

1 Introduction

The continued innovations and advances in computer vision, mobile/cloud computing and portable display devices have brought about a renewed interest in augmented reality (AR) as a prominent information visualization and interaction medium. In particular, optical see-through (OST) displays are becoming more compact and fashionably designed, and thereby getting accepted to the mass users. As for interaction, early OST-based AR systems have relied mostly on simple command or menu based methods e.g. via voice or button/touch input [1, 2]. Recently, light and small mountable sensors (e.g. camera, depth sensors) have allowed for more natural interaction [3, 4, 5].

However, most such AR interaction techniques are focused on direct interaction with close virtual objects within one's reach (e.g. using hands)[6, 7, 8, 9]. Interacting with distant objects, especially those that are real, has not received much attention. The most popular method is using a hand-held device to control a cursor on the AR display to indirectly designate a target object. This may not be the most natural and efficient method. Moreover, such a cursor based method can only be used on the overlaid display space in optical see-through glasses, but in most AR glasses, the augmented display is overlaid on a small part of the entire visual field. Also, in OST based AR systems, one significant concern remains with regards to the multi-focus problem, i.e. the user having to frequently switch one's focus between an object of interest in the real world and the augmentation (e.g. a cursor) on the glass display.

In this demonstration, we propose, "Blurry (Sticky) Finger," in which one uses the unfocused blurred finger, the sense of proprioception and ocular dominance, to aim, point and directly select a distant object in the real world with both eyes open for the purpose of further interaction [10]. Figure 1 illustrates the basic concept and how such a technique could be effectively used e.g. for object query system using a see-through glass. In a typical scenario, the user focuses on and selects an object in the real world (by proprioceptive pointing and designation), which in turn is captured by the on-glass camera and then identified and recognized for final augmentation. Such an object selection method can be used regardless of the coverage of the augmentation screen because it does not require the use of the cursor. Note the "blurry" fingertip is used for aiming to (with the aimed position adjusted according to the offset between the eye and mounted camera in the camera image) and designating the target object (possibly with help of a technique such as lazy snapping).

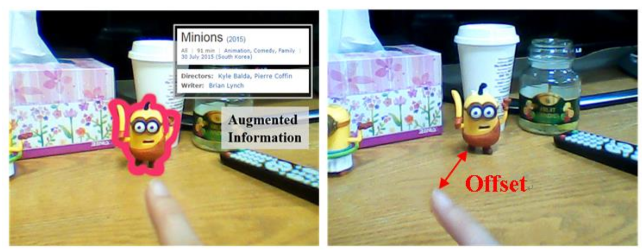

Figure 1: Blurry (Sticky) Finger: proprioceptive pointing and selection, using the finger to point at (and even segment) the target object but without focusing on it (thus blurred) and, relying upon the proprioceptive sense (user view, left). Due to the difference in the positions of the user eye and camera, there is an offset that must be corrected to identify the intended target point in the camera view (right).

2 Demonstration Set-up

To fully demonstrate the advantage of the Blurry Finger, we plan to run two applications, one experimental and the other more practical. The first illustrates the workings, accuracy and usability of the proposed method with the target objects lying at a fixed depth on a monitor. As shown in Figure 2, the user is asked to use the Blurry Finger method to make a series of selection of square objects of various sizes appearing on the monitor. The user aims at the target with the finger and stay on the aimed object for 1 second to indicate a final selection. After a successful selection, the next target would appear at some other location on the screen. Through such a process the visitor/user can appreciate and understand how pointing with both eyes open with the aiming finger blurry can actually be an accurate, intuitive and effective method for object selection.

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The second application is a more exemplary and practical application of the Blurry Finger. The user aims and encircles a real object in the 3D environment (see Figure 3). The encircled image of the target object is captured and segmented out with the eye-to-camera offset compensated. Then the image segment is sent to a data base for a match (Google Cloud Vision) with the result augmented on an OST display (Liteye LE-500).

Both demonstration systems use almost same set-up. The users wears a head mount gear with a USB camera (with an FOV of 40˚ × 32˚) which is connected to a smart phone (LG-F320S G2, running the Android operating system) carrying out the required computation. The former experimental system requires a monitor and a computer (to run and situate the target objects) and the latter object inquiry system requires an OST for result augmentation. For an easy detection of the finger, a color marker is worn on the user's fingertip.

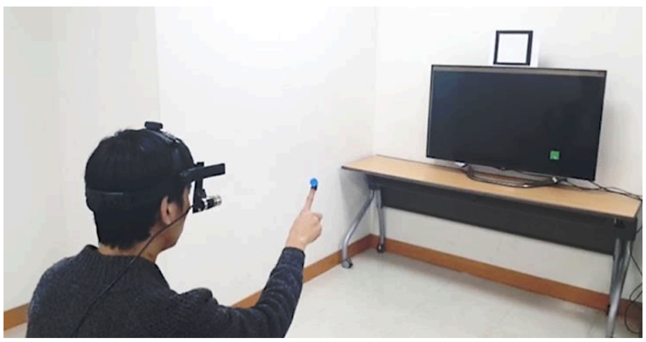

Figure 2: The setup for the experimental target selecting demo: user wears the head mounted camera and the color marker on the fingertip and selects an object at a fixed depth appearing on the monitor.

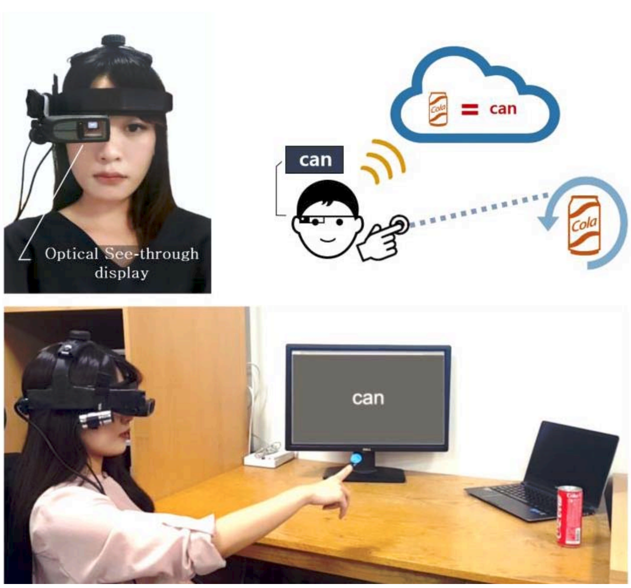

Figure 3: The Blurry Finger based AR based object inquiry system: (top) system set up with the OST display and (below) a scene from actual usage. The user encircles an object in the real world and the captured image is sent to a data base for a match with the result shown through the OST. A monitor could be used to show the glass/camera view to the audience.

3 Contribution

The demonstration of our method is unique because rarely there has been a system that allows the user to select a real object in an AR setting. Even though the aiming fingertip was perceived to be blurred due to binocularity, the correct object can still be selected without much error because our perceptual systems internally use just one dominant eye. Such a feature is somewhat difficult to convey solely in words.

The suggested technique relies on one's innate proprioceptive sense and hand-eye coordination, and can reduce the eye stress due to the multi-focus problem in OST glasses. In addition, being a cursor-less approach, it can be used for any types of AR glasses with differing degrees of screen coverage (with a camera). We believe that these characteristics of the Blurry Finger will draw the interest of the crowd as a viable means for natural interaction for OST based AR applications, and given them an eye-opening experience.

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