Resolving View Difference between Eye and Camera for Proprioceptive Pointing and Selection in Augmented Reality Applications

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1 Introduction

In this poster, we propose "proprioceptive" pointing (and selection) in which we use the finger and the sense of proprioception, without focusing on the finger, to point and select an object in the real world for the purpose of further interaction. The assumption is that this will reduce user fatigue since the user will switch one's focus less frequently, while still being able to point effectively through the proprioceptive sense. Figure 1 illustrates the concept and how such a technique could be effectively used e.g. for object query system using a see-through glass. In this typical scenario, the user selects an object in the real world (by proprioceptive pointing/designation), which in turn is captured by the on-glass camera and then identified and recognized for final augmentation. Note the "blurry" fingertip used for aiming to the target object.

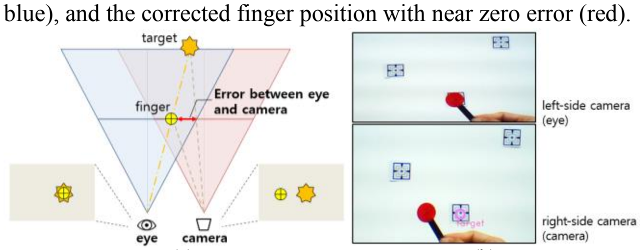
Figure 1: *Proprioceptive pointing and selection: using the finger to point at the target object but without focusing on it and, relying upon the proprioceptive sense. The error between the camera and eye view is resolved to correctly segment out the target.*

2 Finding the finger (and the aimed target)

In order to support the proposed "proprioceptive" pointing, it is necessary to track the finger position in the camera image space and use it to ultimately identify the aimed target object in the line of sight. Tracking of the finger itself can be accomplished relatively easily employing conventional finger tracking algorithms. The problem is that the camera view point is slightly different from that of the user's eye. This can lead to identifying the wrong target, thus it is necessary to adjust the finger position in the camera image space as illustrated in Figure 2 (a).

Most previous work related to resolving the view difference between the eye and camera are based on the spatial calibration between the two coordinate systems, and given a corresponding image object or known reference 3D object. Recent work have attempted to calibrate the two continuously and compensate for parallax errors due to the variations of the HMD position with respect to the eye in actual usage [Luo et al. 2005]. In our case, we focus on dealing with the parallax error, caused by only knowing the line of sight to the target object, through interaction.

Figure 2 shows the formulation to estimate the differential with an assumed value of the eye-to-finger distance (e.g. ~30cm) and the eye-to-target-object distance. While these assumed values are sources of inaccuracy, the slightly erroneous finger position will tolerable for a sufficiently large aimed target object overlapped through the line of sight. Figure 2 (b) shows the test implementation, namely, the views from two cameras and the adjusted proxy position extending into the correct target. Figure 3 shows the amount of the error increasing and saturating with the target object distance (dotted blue), and the corrected finger position with near zero error (red).



(a) (b)

Figure 2: *(a) The need to adjust the finger position in the camera image space to identify the correct target through the line of sight. (b) Views from two cameras and the adjusted proxy position (pink dot in the right) to overlap with the target (square).*

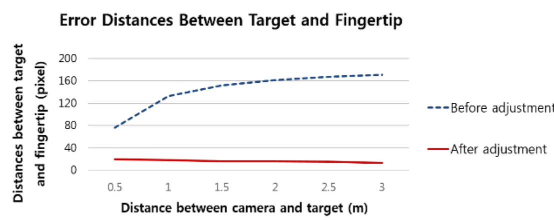


Figure 3: *Error between the target and fingertip stays low after the adjustment process regardless of the target object distances.*

3 Conclusion

As for future work, we plan to complete an augmented reality based object query system and experimentally validate the effectiveness the proposed approach, e.g. whether objects can be aimed and selected properly with the "blurry" finger and relying on proprioception. In reverse, we will also explore for the proper range of assumed parameter values (e.g. eye to finger distance) and the smallest selectable target object size and distance.

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References

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