

Supplementary material

- Effects of illumination on detection

Additional experiments were conducted to validate the performance of the hybrid detection algorithm. First, the target spherical object was exposed to flickering lights. A flashlight was used to generate this illumination. The proposed method provides higher accuracy and consistency than the pure HSV filtering.

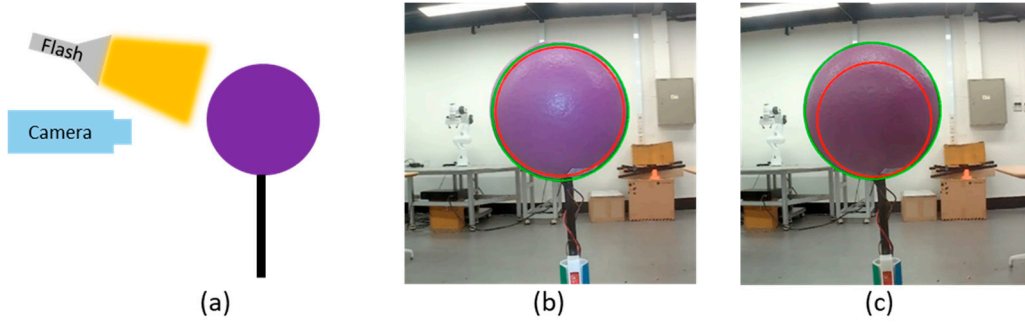


Figure S1. Detection result in the presence of flickering light. The red and green circle represent the detection via HSV filtering only and the detection obtained with the proposed algorithm, respectively.

Second, other circular objects were placed in front of the target object. The proposed algorithm accurately detected the target object even when it was partially covered by other circular objects, as shown in Fig. S2. The detection failed when the overlap was approximately half or more of the target object.

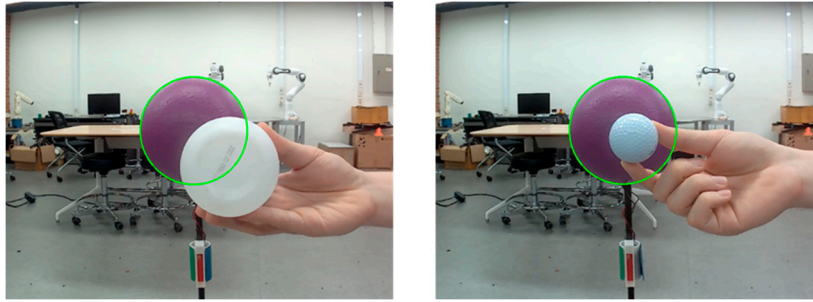


Figure S2. Effect of overlapping object on detection. The green circle edge represents the detection via the hybrid detection algorithm.

- Effects of surrounding objects on detection

Fig. S3(a) shows that the algorithm accurately detects the target object when surrounding objects have different colors. Even if the other object has similar color, the algorithm correctly detects the target object, as shown in Fig. S3(b). This successful detection is possible because it detects the largest object among the objects selected by the HSV color filter. Fig. S3(c) demonstrates an example where it detects a different object. This result suggests that misdetection occurs only when another spherical object has a similar color to that of the target object and is larger than the target object. We have added the following description to explain the limitation.



(a)



(b)



(c)

Figure S3. Results of the additional experiment. The purple ball in the center is the target subject, and the green edge represents the detection result.