# MACHINE LEARNING-BASED BEHAVIOR RECOGNITION SYSTEM FOR A BASKETBALL PLAYER USING MULTIPLE KINECT CAMERAS

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### ABSTRACT

In this paper, a real-time behavior recognition demo system is proposed. By utilizing the captured skeletons and depth information from multiple Kinect cameras mounted at different locations with different view points, the occluded parts of a player and the ball information in the depth channels can be compensated by another Kinect camera without occlusion situations. Besides, a machine learning process trained from the the skeletons and depth channel information from two Kinect cameras makes the the behavior recognition rate to be more than 80% in real-time usage from three of the trained behaviors, i.e. right-hand dribble, left-hand dribble, and shooting behaviors.

*Index Terms*— behavior recognition, multiple Kinects, machine learning, skeleton, depth

## 1. BACKGROUND

Sports behavior attracts the attentions from audiences in a sports game, anchors of a broadcasting, and couch of a team. In the literature, Chen et al.[1] proposed to use two kinect cameras to recognize the posture of a sports (Yoga) player. Hsia et al. [2] proposed to use the skeletons from a Kinect camera for player motion correction for field goal shooting postures. Hachaj et al. [3] verified that Kinect 2 has higher gesture recognition accuracy than Kinect 1. To fully use the skeleton and depth information from multiple Kinect cameras, we propose to train machine learning classifiers for behavior recognition of a basketball player, from the modalities in multiple Kinect cameras, includes: (1) skeletons ,(2) depth of a player, and (3) depth of the played ball.

### 2. IMPLEMENTATION

We implemented a prototype of the proposed behavior recognition system for a basketball player using multiple Kinect cameras. As shown in Fig. 1(a), a player is standing in front of two Kinect cameras mounted at two opposite positions, with the viewing direction between two cameras about 90 degrees. As shown in Fig. 1(b), two Kinect cameras are



**Fig. 1**. The proposed demo system: (a) the user (player) in the field of view, (b) the mounted two Kinect cameras, and (c) the user interface with the behavior recognition results.

mounted on two separated computers, capturing a player with a played ball. As the server side, as shown in Fig. 1(c), the final recognition results are fused from skeletons, depth of a players, and depth of the played ball from multiple Kinect cameras. In the user interface on the screen, the responses of the behavior classifiers are shown along with the time in the right part of the screen.

## **3. REFERENCES**

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