O-Shooting: An Orientation-based Basketball Shooting Mixed Reality Game Based on Environment 3D Scanning and Object Positioning

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***Abstract*—Most of the existing AR applications utilize the built-in camera on a mobile device for pose estimation to display 3D objects in a virtual space. In this paper, an environment 3D infomation is scanned by a depth camera with an object positioning capability for pose estimation, providing reliable 3D object displaying results between a virtual space and a real space. A prototype mixed reality (MR) basketball game called "O-Shooting" is proposed to demonstrate the displaying effect in a mixed reality scenario on a mobile device.**

***Index Terms*—augmented reality, mixed reality, depth camera, mobile device**

I. Introduction

With the widely application applied on portable devices, augmented reality (AR) displaying is shifted from a screen of a computer [1] to a mobile phone [2]. In the literature, most of the existing AR applications relies on markers [3] or simultaneous localization and mapping (SLAM) [4] features points. Furthermore, to interactively display the AR content with the object in the real world can generate a mixed reality (MR) visual effect. To avoid the unstable lighting condition for MR content displaying with a connection to a real world object with an MR displaying effect, we developed a prototype system on a mobile device to display the MR results at the proper position with a virtual interaction to the object in the real space.

II. O-Shooting

A. Environment 3D Scannig

In the proposed, the 3D environment is scanned as shown in Fig. 1 (a) and (b). As shown in Fig. 1 (a), a depth camera

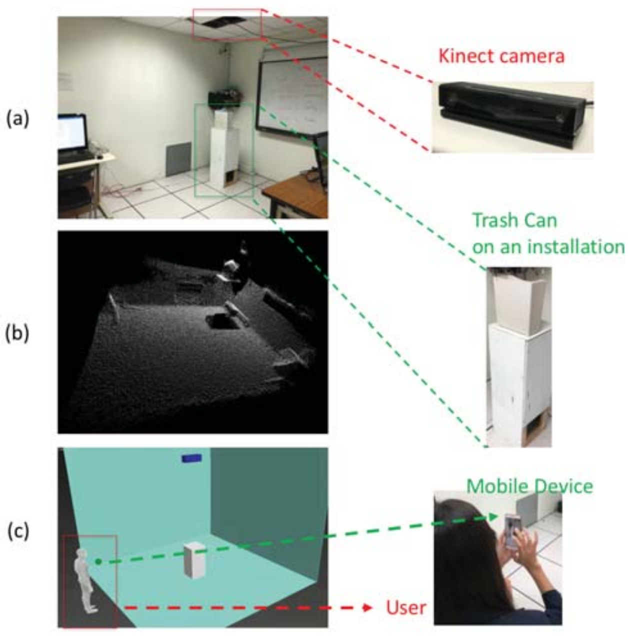

Fig. 1. Environment 3D scanning for an office: (a) the real space of the office, (b) the 3D scanning from a mounted Kinect depth camera, and (c) the virtual space generated in the MR game.

(Kinect) is mounted at the top of the office. The top-mounted depth camera is used to scan the 3D point cloud for the indoor environment, as shown in Fig. 1 (b). After the 3D scanning, the side walls and the floor 3D information can be located and semi-automatically marked by the proposed system.

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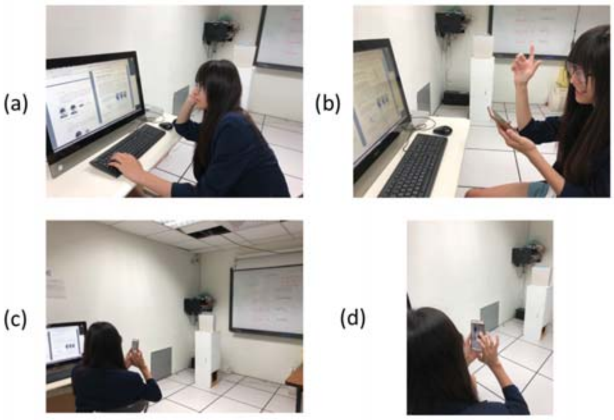

Fig. 2. The Scenario of proposed “O-Shooting”, (a) A tired user staying in the office, (b) the user try to play a basketball MR game with a mobile device, (c) the hold mobile device heading to a trash can in the office, and (d) the user interaction from the mobile device.

B. Object Positioning

Besides 3D scanning, positions of objects located in the 3D environment can be detected according to a head position detection scheme [5]. As shown in Fig. 1 (a), the trash can can be detected from the point cloud shown in Fig. 1 (b). Furthermore, the head location (near the mobile phone shown in Fig. 1 (c)) of the user can also be detected.

III. Implementation and Applications

In the implementation, the real space and the virtual space (Fig. 1 (c)) should be mapped for proper displaying. In addition, the attitude and orientation sensor values are obtained from the mobile device according to “O-Displaying [6]”. The scenario for the proposed “O-Shooting” is shown in Fig. 2. The application setting is that a user staying in an office for a long time and trying to play a 3D MR basketball game to release the pressure in the mood. Before playing “O-Shooting,” the 3D environment need to be scanned, as shown in Fig. 3 (a). A user is sitting in the office and the 3D head position is detection from the depth camera [5]. Because the location of the user’s head and the hold mobile device is very close, a 3D space shift from the head position to the hold mobile device can be empirically adjusted, as shown in Fig. 3 (b). Furthermore, the user is allowed to user his/her finger to move the MR basketball (in the virtual space) and shoot to the trash can (in the real space). Finally, the basketball flying process is shown by the snapshots from the mobile device is shown in Fig. 4 (a)-(d). We should notice that, because the walls are 3D scanned by the proposed method, the basketball is physically reflected by the side wall in the real space (Fig. 4 (b) and (c)), and corresponding displayed in the virtual space with the MR displaying results. As a result, the proposed method can build a bridge from a virtual space to a real space by measuring the 3D environment from the depth camera and locating the mobile device in the real space, calculating the relative 3D relationships among multiple objects.

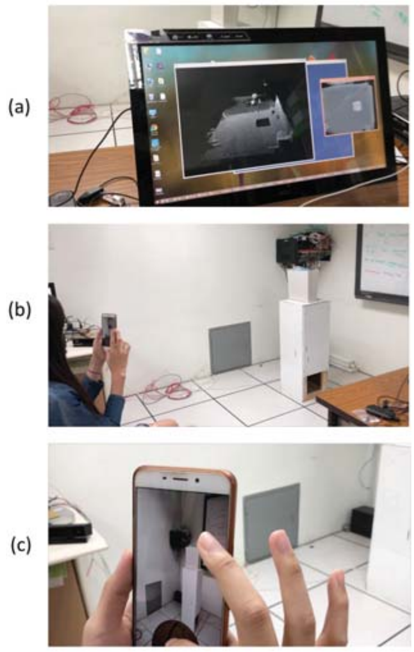

Fig. 3. The implementation for “O-Shooting”: (a) 3D environment scanning and object positioning, (b) the MR game playing scenario, and (c) the MR gaming and user interface on the touch screen.

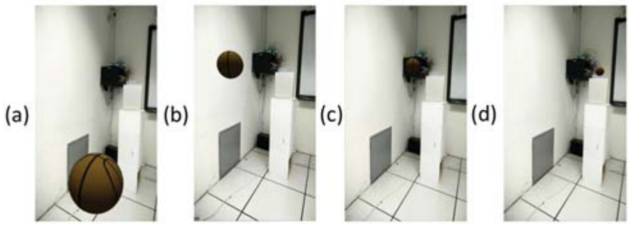

Fig. 4. The MR basketball flying process on the mobile device: (a) ready to go, (b) flying to the physical side wall, (c) reflected by the physical side wall, and (d) flying to the trash can.

Acknowledgment

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