KINECTing Superheroes in MR Space:
Matching Head-Tracking Coordinates and Gesture-Interaction Coordinates

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ABSTRACT

This paper proposes an example of method for integrating a rangefinder-type sensor to a gesture-driven mixed reality (MR) application. The result is an application, "KINECTing Superheroes in MR Space," using the sensor as its space interaction and showed significant improvement of free motion and its limitations of interaction in MR space.
KEYWORDS: Mixed Reality, Interactive System, Gesture

1 INTRODUCTION

Not only visual and auditory mixture but also natural gesture interface is necessary for realizing an immersive MR system (e.g. MR attractions). Nevertheless, it is rare to see such systems because of cost and operative concerns. BLADESHIPS [1] utilizes hand's pose and Hyak-Ki Men[2] utilizes hand motion as its interface but the uses are limited. However circumstances have changed these days because of emergence of cost effective rangefinders such as Kinect sensor and free of charge libraries to manipulate the sensors [3].

This paper proposes an MR application in which a user fights against a menace with super power. The superpower is realized by motions of user's whole body recognized by a rangefinder-type sensor and visual mixture. Possibility of uses of multiple sensors as gesture interfaces in MR applications and method to match their differing coordinate systems is proposed.

2 SETTING MULTIPLE SENSORS

2.1 Selecting Sensors

Followings are criteria for selecting sensors as gesture interface:

Range: The user moves around in space in this system. However, the range is basically limited by length of a cable attached to an HMD. Therefore, the range is limited to about 2 meters.
Occlusion: Iron, mirrors, walls, and lights would affect sensors.
Visibility: It is important for MR applications to place sensors where a user cannot see them not to destroy the scenery.
Burden: Measuring whole body motions requires putting many sensors on the user. However, big sensors and cables attached to them disturb the user's motions. Concerning practical use, getting on and off many sensors on the user are time consuming.

Concerning the criteria, this system adopts a rangefinder-type sensor, Kinect sensor, which can measure bones of the user's body without requiring putting any sensors on the user. The sensor obtains gesture interaction coordinates, but it cannot be used for acquiring head's pose and position (head-tracking coordinates) because of its low accuracy. Then, this system uses optical sensors, Vicon Bonita, for tracking pose and position of the head because the sensor has a wider range.

2.2 Matching Sensors' Coordinate Systems

MR systems using multiple sensors require matching head-tracking and gesture-interaction coordinates systems. Let M_{wp}, M_s, M_p, and s be pose and position of a measuring part in a world coordinates system, those of a sensor in a world coordinates system, those of a measuring part in the sensor's coordinates system (gesture-interaction coordinates), and scale factor, since

$$M_{wp} = s(M_s M_p)$$

M_s can be easily obtained by using a sensor defining world coordinates, in this case, Vicon Bonita.

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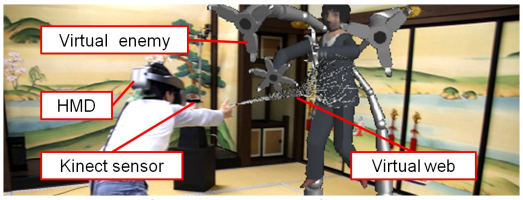

Figure 1. Concept image: Spiderman mode

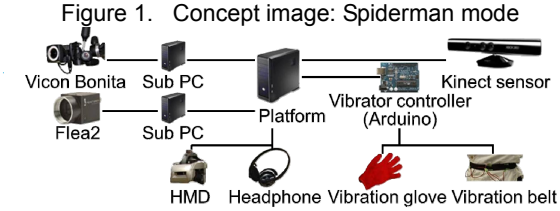

Figure 2. System configuration

3 SYSTEM OVERVIEW

This application has two modes: Spiderman mode and Incredible Hulk mode (See **Figure 1**). Details are shown below.

Spiderman mode: In this mode, the user can shoot a virtual web to attack the enemy. The web comes out from the user's wrist by swinging the arms. The power varies depending on the user's pose.
Incredible Hulk mode: In this mode, the user can cause virtual cracks by trampling down the feet to attack the enemy. The power also varies depending on the user's pose.

System configuration is depicted in **Figure 2**. This system manipulates Kinect sensor through OpenNI library [3] and has a spectator camera. Flow of experience of application is followings: Mode select, tutorial, battle, and game over.

4 CONCLUSION

This paper proposed a gesture-driven MR application, "KINECTing Superheroes in MR Space", method for selecting sensors and matching multiple their coordinates systems, and demonstrated uses of a rangefinder-type sensor in an MR application. The sensor presented a significant improvement of space interaction in MR and showed a limitation; it should be placed in front of a user and that is visually obstacle for MR applications. Therefore, future work will include visual removal of the sensor using diminished reality technologies.

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