Web-based Interactive System for Live Actors in MAR

Extended Abstract

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ABSTRACT

Live actor and entity (LAE) is a system that displays live actors in a virtual scene, and the application enables the scene to be experienced through an immersive display. The LAE system has high potential because it allows a live actor to interact with virtual objects by using gamepad controllers, which have full-set sensors such as 3D orientation sensors and position sensors. With the controller, the live actor can seamlessly drag and drop objects as well as handle the action on a button in the 3D virtual world to perform any triggered events specially defined in the LAE system.

CCS CONCEPTS

• **Computer graphics**; • **Interaction technique**;

KEYWORDS

Interactive object model, Live actor and entity (LAE), Mixed augmented reality (MAR), ThreeJS, WebXR

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1 INTRODUCTION

In the last period of the modern era, technological evolution in virtual reality has resulted in major and remarkable applications such as gaming, entertainment, and user interfaces. However, merely providing a virtual display is not enough to fully realize an experience close to real-life emotions. Thus, attaching the ability of interaction into the system plays an important role in upgrading the level of virtual reality.

This paper proposes an interaction technique for the live actor and entity (LAE) system in which a live actor, whose complete human body is constructed as a model in a 3D virtual world, can interact directly with virtual objects and handle events. Technically, the application of sensing data from a gamepad is necessary for translating controller behaviors to three-dimensional coordination. Briefly, through the proposed technique, the interaction can be used to handle actions, which are triggered based on the sensing information of the gamepad.

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2 INTERSECTION WITH PLANES BY USING THE SENSING INFORMATION OF GAMEPADS

The information from sensors installed in controller devices is tracked to detect handling actions and sensing data such that users can directly reach out and grab objects in the virtual space. Mapping sensors in the real world can be used for performing activities in the nonphysical world as a way to navigate through the intersection concept, allowing a user to interact with virtual objects.

Through this intersection, events can be called according to the definition of an object. In the LAE system, the objectives of an action fundamentally serve to handle a button-click event and to reposition an object. As shown in Figure 1, a line passing through the points A(x, y, z) and B(x', y', z') is known as a hypothesis for finding the intersection with a plane formed by P(x, y, z), Q(x', y', z'), R(x", y", z"), and S(x"', y"', z"').

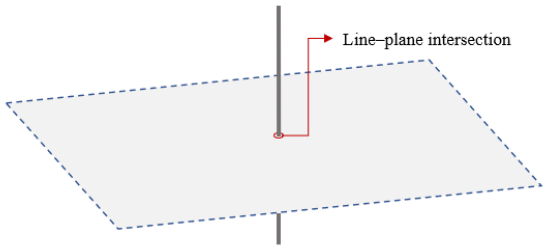

Figure 1: Intersection of a line and plane.

3 MAR SCENE

According to Chheang and Yoo [Chheang and Yoo 2017], mixed augmented reality (MAR) represents a continuum that encompasses all domains or systems that use a combination of real and virtual representations. Hence, MAR is defined as a mixture of real and virtual representations but excludes purely real and purely virtual environments.

The proposed system implemented an MAR scene with ThreeJS [Cabello 2010], which can create and display animated 3D computer graphics. Moreover, it has useful APIs that work seamlessly as Web3D content and easily manage virtual objects with built-in

functions. Additionally, in Tin et al. [Hok et al. 2019], WebXR [WebXR 2019] was implemented a system to access virtual reality and augmented reality devices, sensors, and head-mounted displays in order to provide an immersive display experience of an MAR scene.

Scene description—it is used to perform the effective spatial mapping of and event handling of a live actor in an MAR scene. In the proposed system, since various events are defined, an event database is created and used to map the recognized target signals to events in the virtual scene.

4 IMPLEMENTATION AND RESULTS

To find the intersection of a line and plane, the vector of the line $\vec{r}$ must first be solved for using the following equation:

$$\vec{r} = \mathrm{A} + t\left(\overrightarrow{AB}\right)$$

By simply determining the direction of a line $\overrightarrow{AB}$, the vector of the line $\vec{r}$ can be known. In addition, the equation of the plane must be formed:

$$a(x - x_o) + b(y - y_o) + c(z - z_o) = 0$$

From the 4 points of the plane named P, Q, R, and S, the vectors $\overrightarrow{PQ}$ and $\overrightarrow{RS}$ can be found. In addition, $(x_o,\ y_o,\ z_o)$ can be any point on the plane. Importantly, the perpendicular to the plane $\langle a,\ b,\ c\rangle$ must be determined by taking the cross product of the vectors $\overrightarrow{PQ}$ and $\overrightarrow{RS}$.

As stated in Tin et al. [Hok et al. 2019], the system has the ability to virtualize actors by reconstructing a human body as a 3D model in the virtual environment. Inspired by Yoo [Yoo 2016] and based on the actor model, the system provides users the ability to interact with virtual objects by using controllers, which are recognized as line models. Again, the plane model is attached to an object implemented to detect a specific handling event. Thus, through the sensing information and intersection technique, the procedure of interaction shown in Figure 2 can be realized relative to real behaviors.

Figure 2: Process structure of a live actor's interaction.

Sensors—the target data is focused on sensing information from attached sensors, and the sensing data are used for triggering specific actions or events. In this context, we proposed the use of sensing data as the action to trigger an interaction event. In addition, the sensor is precisely described in Chheang and Yoo [Chheang and Yoo 2017].

Recognizer—the recognizer and sensor function relative to each other. By obtaining the sensing data, the recognizer is responsible for understanding and translating data that can be readily prepared for an event mapper. Here, the recognizer attempts to understand the sensor data.

Event mapper—as an important aspect of this paper, the event mapper operates on the concept that interaction can trigger an event in conformity based on recognized data. This approach has been described in the above section on the event mapper.

Consequently, the implemented system can produce an exceptionally strong relation between the sensing data and mapped interaction events. As Figure 3 shows, live actors can freely interact with object models.

Figure 3: (A) A live actor interacts with object models. (B) An interactive model designed as a video player.

5 CONCLUSIONS

In this study, we advance previous work [Hok et al. 2019] by taking two important steps. One is to track information from sensors for translating controller inputs. The second is to determine the intersection point between a line and plane. By combining the work of Tin et al. [Hok et al. 2019] with the proposed interaction technique, we can develop a high-performance system for virtual 3D applications that provides a wide variety of practical benefits.

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