

Interactive Spatial Augmented Reality System for Chinese Opera

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ABSTRACT

In this research, the authors designed an interactive spatial augmented reality system for stage performance based on the technologies of UWB positioning and Bluetooth triggering. The position of the actor is obtained through the antenna tag carried by the actor and the signal base station placed on the stage. Special effects can be triggered through the Bluetooth module according to the actor. The system has a higher degree of freedom in practical applications, which can present an interactive spatial augmented reality effect, and therefore provide new possibilities for the application of spatial augmented reality in the stage performance. The system could bring better immersive experience to the audiences, and it also brings new possibilities for the aesthetic creation of opera.

CCS CONCEPTS

• Applied computing → Media arts;

KEYWORDS

Ultra-Wideband (UWB) Positioning, Spatial Augmented Reality (Spatial AR), Stage Performance

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1 INTRODUCTION

In some Chinese opera of fairy tale themes, fusing elements of mythology into the performance seamlessly could greatly enhance the immersive experience for the audiences. In order to achieve a better result of virtual-real fusion, the positioning of virtual elements on the stage is also an important point. In the existing augmented reality stage system, it is common to use the Microsoft Kinect sensor, XSENS, etc. to capture the actions of the actors on the

stage and transmit the position information [Alexiadis et al. 2011; Clay et al. 2012; Marner et al. 2012]. However, the detecting range of Kinect is within 4.5 meters, the scope of the actor's activity may exceed the capture range of Kinect in large-scale performances, resulting in the loss of location information. At the same time Kinect placement may also interrupt the view of the audience. While infrared positioning technology could provide wider tracking range, but a special prop is needed and no occlusion is allowed.

In this paper, a new positioning scheme based on UWB positioning was designed. The actors can trigger virtual effects dynamically and autonomously through a trigger module hidden in the costume. The system can present more precise positioning functions of the special effects in the stage performance, which also brings a more immersive spatial augmented reality stage visual experience to the audience.

2 SYSTEM DESIGN AND IMPLEMENTATION

2.1 System design

It is necessary to arrange the base station on the stage, the number of which can be 3 4. The location of the base station is shown in Figure 1. The antenna tag used by the system is worn by the actor during the performance. It is a rectangle of about 51mm*15mm*36mm. It can be hidden in the actor's general costume items, get the real-time position of the actor, and then send the coordinates to the Unity3D's show program. According to the coordinates, Unity3D forms an invisible point as a special effect position on the screen.

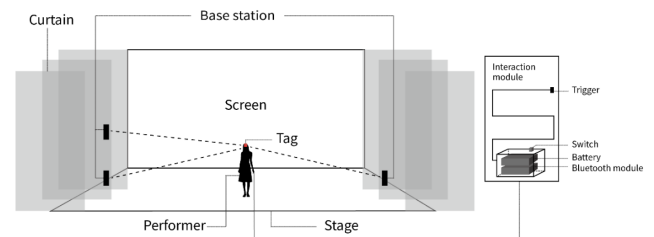


Figure 1: Module arrangement on stage.

2.2 Tracking ,Fusing and interaction

Based on the Ultra-Wideband (UWB) technology, the tracking system consists of two modules: the Mini3UWB signal transmitting

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module (Tag) and the Mini3Plus fixed position sensor (base station). This hardware was developed by YCHIOT, a company in Wenzhou, Zhejiang, China. The signal flight time between the tag and the base station is obtained by the transeiving response frame gap between the base station and the tag. Effective communication distance of modules is more than 150 meters. The communication distance is more than 100 meters if it is being blocked by cloth.

Meanwhile, since the special effects are presented on the screen of the stage, when the actors are far from the background, the special effects coverage needs to be appropriately expanded, so that the special effects and actors form a consistent visual effect in the eyes of the audiences, avoiding excessive visual dislocation (as shown in Figures 2).

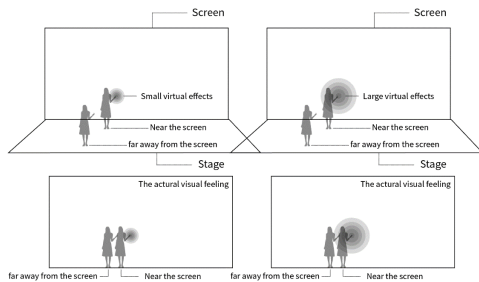


Figure 2: Relative position of actors and special effects.

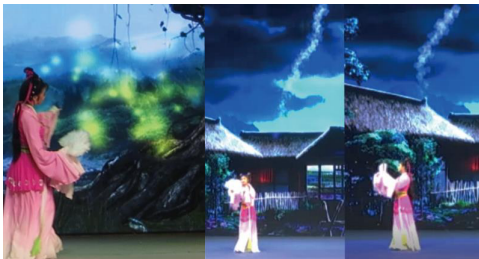


Figure 3: Increased special effects and visual contact with the actor's position.

The interactive module is small and can be fixed in the inner garment of the actor. The small switch is exported from the Bluetooth module and extends from the inside of the actor's outer garment to the position where the actor's hand or wrist can be blocked by the clothes and easily triggered. The Bluetooth trigger module sends a status command to the receiving device continuously, and the actor modifies the status command by triggering the switch. In the show program created by Unity3D, the background receives state changes and executes virtual special effects rendering commands.

3 APPLICATION AND RESULTS

The cost of the whole system is about \$597. The system can be reused in the play of constantly changing performance scenes. At the same time, it can save rehearsal time for actors to cooperate with screen effects. The system has been used in a series of traditional Chinese plays. In the performance of the Chinese traditional

repertoire "Marriage of the Fairy Princess", the base stations were hidden behind the stage curtain to avoid the interfering of visual effects. The antenna tag is hidden in the actress's hair to ensure that the signal has less interference.

Figure 4 shows the effect triggered by the system at the actor's position (include smoke, luminous efficiency, lantern rise, beat drum), these effects were generated by Unity using 3D models and particle system. The antenna tag in the actress's hair cooperates with the base station to generate real-time position information, and then the fine-tuning of the control points in the Unity program focuses the position on the actor's hand range, accurately tracking the actors to make a step, turn and other actions after triggering the virtual special effects. Bluetooth triggering signal will be send to COM port on the workstation, Unity program will detect it and then trigger the predefined virtual special effects or interact with virtual objects.



Figure 4: Varied effect triggered.

4 CONCLUSIONS AND DISCUSSION

The system designed by the authors realizes the functions of remote triggering, real-time tracking, and virtual-real fusion of performer and virtual effects on the stage. Thus a more realistic and immersive atmosphere can be realized.

The system could provide a better viewing experience for the audience, and also brings a much broader performance space for opera art, opera directors need to take into account the characteristics of new technologies in the stage of script creation in order to achieve better harmony between technology and art. It also offers more possibilities for the combination of rising technology and traditional art.

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