

# Ensemble3D: Interactive 3d scene creation system with multiple roles and devices

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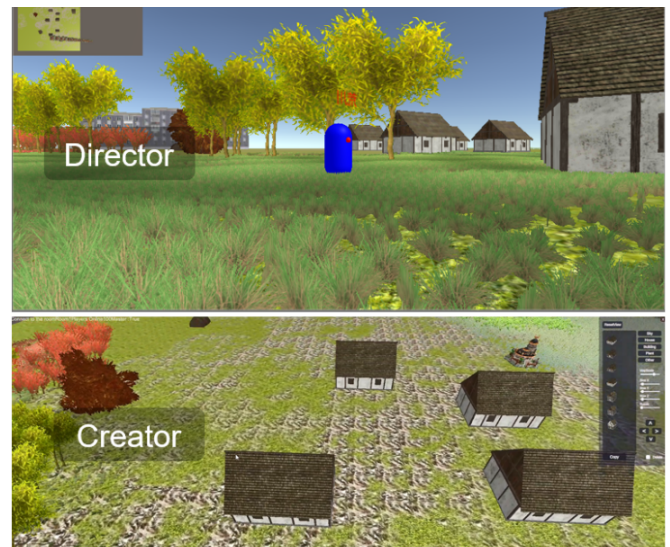
**Abstract** We present ensemble3D, a shared virtual world to create 3D content such as video games and CG movies. Generally, 3D content is created by multiple professionals who have different specialties. For instance, creators design 3D objects and scenes, while directors check the designs to develop the quality. However, each task is achieved by different individual workspaces, so much time is spent combining the results and completing the content. Therefore, we designed a shared virtual world that allows creators and directors to share a 3D scene at the same time. In the joint workspace, the director's comments and requests are smoothly responded to by creators. Moreover, our system supports multiple devices, such as HMD, tablets, and PC. In this paper, we describe our ensemble3D, focusing on the concept, design, and implementation.

**Keywords** 3d cg; interactive cg; shared virtual world; multiple roles

## 1 Introduction

With the development of 3D computer graphics (CG) techniques, we can experience rich 3D CG in countless video games and movies. For example, software technology provides a wide variety of expressions, and high-speed hardware technology supports effective rendering of the expressions. In hardware technology, the graphics processing unit (GPU) has been getting cheaper, so we can see 3D CG operated smoothly without any delay. Additionally, a wide variety of devices that can use 3D CG have appeared; even some mobile devices support GPU. Head-mounted display (HMD) allows users to reach deep into the 3D world and interact intuitively with virtual worlds. The wearer can change his/her view direction just by changing his/her head angle. However, much time is spent creating video games and movies with 3D CG, because content creation requires many different roles and tasks.

The process of 3D CG content creation has remained virtually the same since 3D CG became used for game and movie content. 3D content creation is divided into several parts and roles. First, a storyboard is created to share the director's images of the content with rough drawings. Next, 3D designers create scenes, characters, and effects to complete the designed 3D world. In this case, designers use modeling applications personally, and programmers add motion and behavior to 3D static objects. Then, directors check the quality of the content and comment on it or request changes to fit their image. Directors must take responsibility for whether the content is accepted by consumers or not. These two processes—shifting between the director's comments and the creator's responses—continue until the director is satisfied with the quality of the content. These processes between the creators and the directors are the most time-consuming step. Thus, it is essential to provide an effective method for the director to check 3D content and for the creator to respond smoothly to the director's reactions.



**Fig. 1** Ensemble3D: Both directors (top) and creators (bottom) can work on the same scene simultaneously.

To establish smooth communication between director and creator, a remarkable user interface must be designed, because the director and the creator need different functions. The director's role is to browse and check the designed 3D scene, so a browsing function is essential. In contrast, the creator's role is to create and edit the 3D scene, so some graphical user interfaces (GUIs) supporting creation activities (e.g., setting and modifying objects) are needed. Thus, the system should be carefully designed to provide sufficient workspace to support each task.

Therefore, we have developed Ensemble3D, which allows directors and creators to share the 3D world simultaneously (Fig. 1). We provide a shared virtual world in which director and creator can communicate smoothly. In our shared virtual world, the directors can wear an HMD or use a mobile device/PC to check 3D content, and the creators can edit 3D content depending on the director's comments. Moreover, the shared world supports multiple directors and creators in the same 3D scene, so a creator can respond a director's request quickly. The system[1] can hold a maximum of twenty participants. In this paper, we describe our Ensemble3D focusing on design, implementation, and demonstration.

## 2 Ensemble3D

Our Ensemble3D is a shared virtual 3D scene that simultaneously allows creators to design and create 3D content and allows directors to check and browse the content. In our current prototype, we focus on a 3D scene creation, because 3D scenes are a base element in the creation of video games and movies.

### 2.1 Ensemble3D design

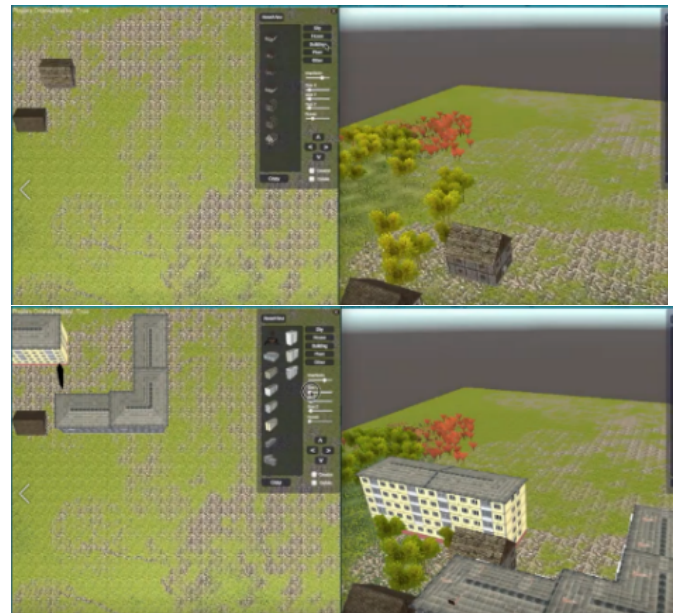
Our approach has two features that enable seamless and effective communication and collaboration between directors and creators.

One feature is that our system supports multiple directors and creators in the shared virtual world. Storyboard[2] effectively provided a shared workspace that allows a creator to sketch animation content and a director to check the drawing in a 3D scene. However, the system only supported a single creator and director. In contrast, we designed a unique workspace as a virtual 3D scene that allows multiple directors and creators to work on different tasks. Generally, many creation tasks and processes go into content creation, so multiple creators create content more effectively than a single creator. Although many systems share 2D documentation and drawing workspaces across multiple users, 3D shared workspaces are not as mature.

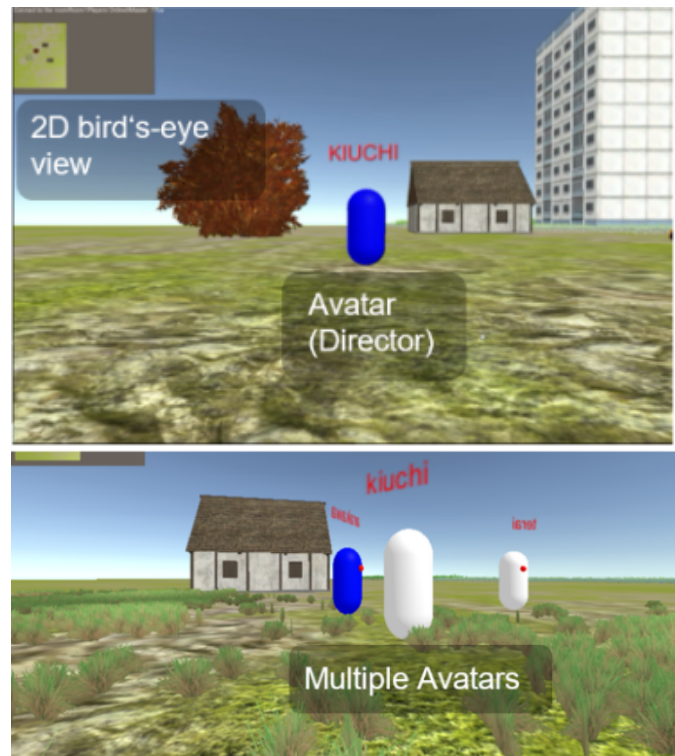
The other feature is that our system supports unique communication in both the virtual and the real world. To enhance collaboration and communication, we provide two communication models. One model is a collaboration among creators and directors through a virtual 3D scene in which 3D scenes and objects are shared. In this collaboration, multiple creators design and create 3D objects and scenes, and multiple directors check them interactively. The other model is oral communication among creators and directors in the real world, through a meeting space in the real world. In this case, directors give comments to each creator directly, and the directors can see both the results and processes of 3D scene creation. The 3D scene is directly changed by the creators' activities. Additionally, creators can check directors' behaviors. Fig. 2 shows an example of how a director and three creators communicate with each other. The director comments on a 3D scene, and creators modify the scene depending on the comments.

### 2.2 Creator

The system provides the creator's GUIs, which contain predefined 3D objects to support the creator's activities. The creator's workspace is divided into two areas, a shared 3D scene and GUI areas, which supports the creator's activities, including creating and editing objects (Fig. 3). In this example, a director (represented by a white avatar) joins and browses the scene. An orange cube appears above an object when a director sees it. Thus, here the creator understands that the director is focusing on the house.



**Fig. 2** Creation by two creators. When one creator sets a new building, it appears in the other creator's workspace.



**Fig. 3** Director's UI: Each director browses the 3D scene and is represented by a simple avatar (top). If multiple directors attend the same 3D scene, multiple avatars appear (bottom).

In the shared 3D scene area, creators can select a viewpoint from both 2D and 3D views. From the 2D viewpoint, they can see the entire scene in a bird's-eye view and can set 3D objects roughly. From the 3D viewpoint, they can see the 3D scene in detail and can adjust the position, scale, and direction of 3D objects.

In addition, a creator can see other creators and directors who join the 3D scene. Fig. 3 shows a simple example of two creators sharing



the same virtual world. When one creator sets a new building, it appears in the other creator’s workspace. As in this example, two creators can share a task, and each participant can recognize what the other participant is doing just by seeing the 3D scene.

The system provides some GUIs that contain predefined datasets and edit functions. Several types of object data (such as 3D models and 2D images) are included in the GUI area, so creators can select an object from the datasets and put it into the 3D world. After setting the object, they can edit it by manipulating transform sliders in the GUI area, such as by changing position, size, and rotation. By continuously using these manipulations, creators create 3D scenes. Although our current prototype does not provide modeling functions, creators can import external 3D models and 2D images and use them as a part of the datasets to create a 3D scene.



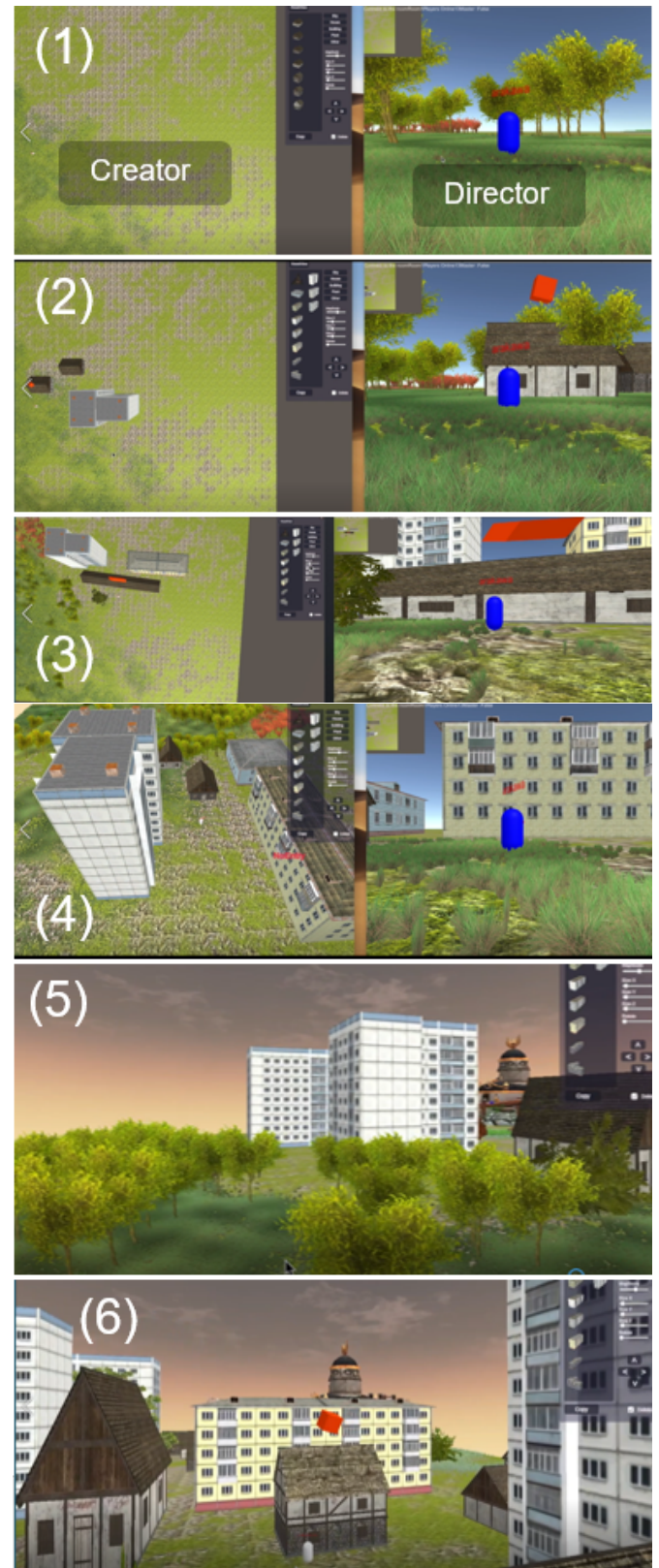
**Fig. 4** Multiple devices and participants: directors can choose HMD or mobile devices to browse a shared virtual world (top left). Multiple participants share the same 3D scene (top right). When a director wears an HMD, his/her avatar does not appear (bottom).

### 2.3 Director

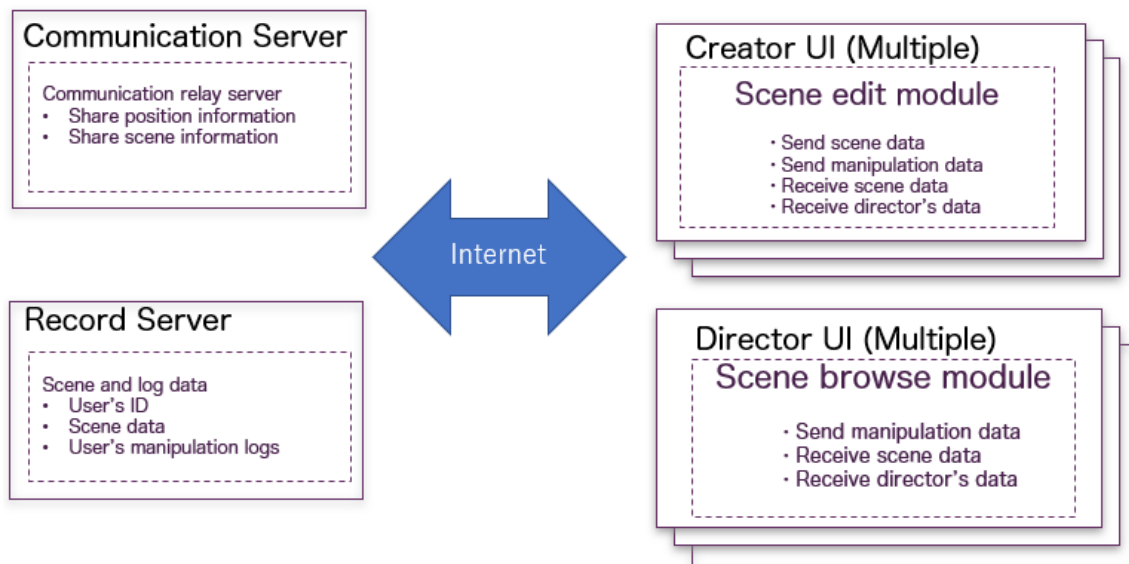
The system supports the possibility for multiple devices (e.g., HMD and mobile devices) to browse a 3D scene. The director's workspace is divided into two: a 2D bird's-eye view and a 3D scene browsing area. Through the bird's-eye view, a director can see the entire scene and where other directors are. In the browsing area, the director can move around the 3D scene and change his/her view angle in order to see each object in detail.

A director appears as an avatar when s/he joins a shared virtual scene. Each avatar is represented by a simple shape and the user's name. If multiple directors attend the same 3D scene, multiple avatars appear at the same time. One’s own avatar appears as a blue shape, while others appear as white shapes. Through the avatar's position and

angle, creators can know where each director is and what he/she is looking at.



**Fig. 5** Ensemble creation: A creator and director communicate with each other and created content interactively.



**Fig. 6** Ensemble creation: A creator and director communicated with each other and created content interactively.

Our system allows users to browse the virtual world with both PC and HMD (Fig. 4 (top)). With a PC, a director can manipulate arrow keys to move forward, backward, left, and right. With an HMD, a director can browse the virtual world with a joystick and look around just by changing his/her head direction. When a director wears an HMD, his/her avatar does not appear (Fig. 4 (bottom)). In this Fig., an orange cube appears above an object when a director sees it.

### 2.4 Example of 3D Scene Creation

Here, we demonstrate how a 3D scene is created with our system. Unlike conventional systems[3, 4], the director can check both the results and the processes of the 3D scene creation. Fig. 5 shows how the creator and director create a 3D scene. In Fig. 5 (1), a creator (Fig. 5 (1-left)) and a director (Fig. 5 (1-right)) attend a shared virtual world and use different UIs. The director is represented by a blue avatar. If the creator sets objects in his/her workspace, the objects immediately appear in the director's view, because they share the same 3D scene (Fig. 5 (2, 3)). In Fig. 5 (4), the director requests that a building size be changed, so the creator changes the size interactively. Finally, the 3D scene is created (Fig. 5 (5, 6)). With an HMD, the director can browse a 3D scene naturally, so he/she can change his/her view in the scene just by changing his/her face direction.

## 3 Implementation

Fig. 6 shows the overview of our implementation, which contains two user interfaces and two servers. As our system allows multiple directors and creators to join the same 3D scene simultaneously, every manipulation by a participant is done through the cloud server.

In the user interface parts, we implement two user interfaces for directors and creators by using Unity[5] to achieve our design. The creator interface provides template 3D objects (e.g., houses, trees,

buildings) for creators to design a simple 3D scene. Unity also supports multiple devices (e.g., PC, smartphone, tablet, and HMD), so our system can be installed on multiple devices without special settings. For creators, the server stores their manipulations like creating, transforming, and deleting objects. For directors, the server stores their path, or how they moved around a 3D scene.

As for the servers, we use two cloud servers to achieve a shared virtual world and support multiple users successfully. One server records scene data and participants' behavior logs. In terms of scene data, the server stores 3D models, materials, transformations (e.g., position, size, and rotation), and environmental information (e.g., lighting and camera). In terms of participants' behaviors, the server stores both directors' and creators' manipulations. The second server handles communication information to reflect each participant's manipulations in the shared virtual world. As found in simple tests, our system can treat twenty creator and director participants in the same 3D scene.

## 4 Discussion

Although we have not finished practical user tests, we discuss our system based on the comments and reactions we have received through our demonstrations.

Our system allows multiple directors and creators to attend the same 3D scene and create 3D content effectively. Our design concept was well accepted by observers. In our system, a director who wears an HMD can experience a creator's manipulations immediately, as the director's comments are quickly implemented by creators who share the same 3D scene. Furthermore, our system can support a wide variety of collaborations. Generally, the number of creators and directors varies depending on the content. The quality of a PC game is higher than the quality of a smartphone game. Our system can flexibly control the number of participants, so we think that our system could be

useful for a range of games, from simple smartphone games to complex PC games.

In our current prototype, creators can only use template 3D object data. Although our system can load and use 3D data created by other modeling software, interactions in our system are limited. Materials and effects in particular are not supported. Although our target user is non-professionals, simple interactions are needed. We are planning to develop our system to create a more complex scene and co-create content with simple interactions[6-8]. Also, navigation techniques are important to move a target and focus area quickly. We will combine our system with other interaction techniques[9] to achieve more natural navigation.

Some visitors commented on online communications. We were primarily concerned with content creation in a local environment, where directors and creators are in the same room. Although we provide online communication options by integrating with Skype and Facebook, directors and creators have to use different workspaces. Due to this gap, users have to see both workspaces. To achieve more natural communication between the virtual and the real world, we will develop our system to support both in the same workspace.

## 5 Conclusion

We described Ensemble3D, which is a shared virtual 3D system to enhance creation and communication. In our system, multiple creators and directors could share the same 3D scene. In the joint workspace, the director's comments and requests were smoothly responded to by creators. We discussed the design and implementation and then showed how to use our system.

After developing our system further to provide more effective interactions, we will evaluate our system through practical user tests.

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