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VR TOUR: GUIDED PARTICIPATORY META-NARRATIVE FOR VIRTUAL REALITY EXPLORATION

VR-TOUR: META-NARRATIVA GUIADA E PARTICIPATIVA PARA EXPLORAÇÃO EM REALIDADE VIRTUAL

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ABSTRACT

Abstract: In this paper we present VR Tour, a platform for guided participatory virtual reality exploration based on a meta-narrative paradigm. Our research takes a practice-led and collaborative approach, whereby our main focus lies on the production aspects of VR applications.

Keywords: Virtual Reality; Meta-Narrative; Storytelling.

RESUMO

Neste artigo apresentamos o VR Tour, uma plataforma para exploração de realidade virtual participativa guiada baseada em um paradigma meta-narrativo. Nossa pesquisa adota uma abordagem prática e colaborativa, em que nosso foco principal está nos aspectos de produção de aplicativos de RV.

Palavras-chave: Realidade Virtual; Meta-Narrativas; Histórias.

INTRODUTION

Virtual reality has been developing at a very fast pace recently. The hardware is improving in terms of both quality and usability. The software is incorporating many techniques that take advantage of current research results.

The above scenario motivates the development of novel applications that expand the possibilities in various areas - such as entertainment, education, industry, and science - and new media modalities - such as 360 degrees video, live cinema, immersive location experiences and VR theater,

On one hand, the main challenge to shape the emerging medium is the development of a new language, supported by suitable creative tools, making possible content production. In that respect, initiatives from organizations like the Oculus Story Studio (OCULUS, 2017), Google Spotlight Stories (GOOGLE, 2017) and the ILMxLab (ILM, 2017), are already exploring this uncharted terrain. On the other hand, a few concrete products recently released give us a glimpse into the future. Some notable examples are: the SIGGRAPH Real-Time Live and VR Theater programs, the Adam series by Unity - Oats Studio (2017), the Hyper-Reality Experiences from VOID (2017) and the Holojam creations from the NYU Future Reality Lab (NYU, 2017), "Holojam in Wonderland" (FRL, 2018) and "To be with Hamlet" (NYU, 2017).

Nonetheless, the quest for the next form of audio-visual communication and entertainment is still in the very beginning — no definitive answer is in sight yet. The problem is complicated by the fact that a solution needs to balance financial, cultural and other aspects in order to be viable for the industry. A strong testimony of this dilemma is the MIT Technology Review article, by Ty Burr, entitled “Hollywood Has No Idea What to Do with VR” (BURR, 2017).

In this paper we present VR Tour, a technological platform for exploration of content in virtual reality. Our research takes a practice-led and collaborative approach, whereby our main focus lies on the production aspects of VR applications. In the following sections we present the core concepts of our proposed platform followed by the conceptual and technical infrastructure which enables it. Then, we detail the elements involved in VR Tour and present a case study using the platform.

1. CONCEPTS

VR Tour promotes a guided participatory meta-narrative exploration of content in virtual reality. The platform has a foundation in the following concepts:

- Meta-Narrative - It is assumed that the content is associated with a story. The exploration of this content uses meta-narrative techniques to present the story.
- Narrative-Based Content - It is assumed that the the story has a narrative structure, that can be fictional, such as a theater play, or factual, such as a documentary.
- Navigation - It is also assumed that the story takes place in a space. The environment is explored through navigation in this space.
- Guided Tour - The exploration is guided by a "host" that directs the participants ("guests") though their journey.
- Participatory VR - The guests experience the tour in a shared virtual reality environment. They can interact among themselves and also with the host.

1.1 Applications

The VR Tour platform has potential applications in many areas. Most specifically, those that deal with story-based content. In entertainment, virtual reality experiences engage participants to exploit the multifaceted dimensions of a story. In museums, exhibits can be enhanced by virtual reality exploration of content, including contextualization. More generally, different forms of education and training are good scenarios for meta-narrative tours.

2. INFRASTRUCTURE

The technological infrastructure used in VR Tour is based on the VR Kino+Theater platform that exploits concepts of Situated Participatory Virtual Reality and Live 3D Digital Cinema.

2.1. VR KINO+THEATER

VR Kino+Theater (VELHO; CARVALHO; LUCIO, 2017) is a new VR platform for storytelling that shares various aspects of Coppola's vision of Live Cinema (COPPOLA, 2017). His proposal is an attempt to combine theater, film and television.

The VR Kino+Theater platform, as in (VELHO et al, 2018), integrates traditional forms of entertainment, such as Theater and Cinema, but employs advanced CG technology, more specifically Virtual Reality and Gaming. In this way, it solves at the same time scalability of audience and presentation familiarity, while providing greater flexibility for innovative alternative formats, such as VR Tour.

2.2. SITUATED PARTICIPATORY VR

Situated Participatory Virtual Reality (VELHO et al, 2017) is a modality of VR that allows the creation of Shared Multi-User Virtual Environments. For this purpose, it combines real and virtual objects in tangible spaces, where the participants, represented by digital avatars, are completely immersed in a simulated world. They use VR headsets and markers for full body motion capture.

The above setting implements the VR Theater component of VR Kino+Theater platform. As such, the actors perform in a VR Stage that is mapped into a virtual set. Figs. 1 and 2 show the real actors performing in the VR Stage and the corresponding action of their avatars in the CG virtual set.

Figure 1 - VR Theater - VR Stage and CG Virtual.

Source: VISGRAF Laboratory

Figure 2 - VR Theater - CG Virtual Set.

Source: VISGRAF Laboratory

2.3. LIVE 3D CINEMA

Live 3D Digital Cinema is the technology behind the non-immersive audio-visual presentation format of VR Kino+Theater. It consists of the Computer Graphics infrastructure for Animation, Real-Time Simulation and Rendering of the experience.

The virtual cinematography framework includes Pre-Programmed Cameras and Interactive Editing for generating the cinematic content.

The above setting implements the Live Kino component of the platform. In this context, the director selects in real-time the views that are shown on the live movie projection screen. Figs. 3 and 4 show the Director operating a multi-camera switcher

during a live presentation.

Figure 3 - Director operating the camera

Source: VISGRAF Laboratory

Figure 4 - Detail of the switcher interface.

Source: VISGRAF Laboratory

3. VR TOUR ENTITIES

The VR Tour is a guided participatory experience of a narrative-based content in virtual reality. In that context, the key elements are the people participating both in the production and fruition sides of the VR experience, the virtual and physical spaces where the experience takes place and the virtual objects used for interaction during the tour.

The VR Tour also follows a Program with a sequence of steps that accounts for the different parts of the experience.

3.1. PARTICIPANTS

The classes of participants that make up the experience can be grouped in:

- The players in the VR Tour Environment, i.e, individuals that can be divided into three subclasses: *Tour Host*; *VR Guests* and *Story Characters*. These players are represented in the VR Environment by digital avatars with different char-

acteristics according to their classes.

- Participants out the VR Tour Environment, i.e., individuals that can be divided into three subclasses: *Regular Guests*; *Director* and *Staff*. These participants only exist on the Physical Environment.

3.1.1 TOUR HOST

The Tour Host acts as a guide that conveys the story to the participants (VR Guests and Regular Guests). Typically, the Host is a real actor/actress that is represented in VR by an avatar that has only the following components:

- Head - to indicate the host position and gaze to the participants.
- Hands - to allow a basic motion expression, such as pointing, for communication with the participants

Figure 5 - Host head and hands.

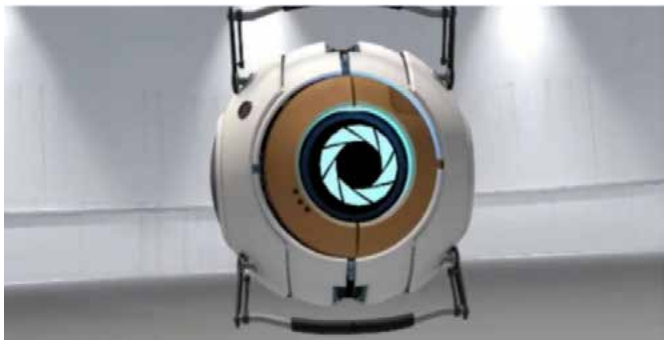
Source: https://mashable.com/2016/12/14/oculus-avatars/

The tour host has also virtual interface elements, such as a HUD, at his disposal in order to control the Tour presentation, as will be discussed in the next sections.

The host can be played live by a real actor or based on a pre-recorded performance previously captured. Another option is to employ a synthetic digital assistant generated using AI (artificial intelligence).

In any case, the visual appearance of the host should be distinctive for easy identification by all participants of the experience. Also it should reflect his nature, for example, an artificial hosts could be depicted as a robot, as shown in Fig 6.

Figure 6 - Artificial Tour Host represented by a robot.



Source: VISGRAF Laboratory

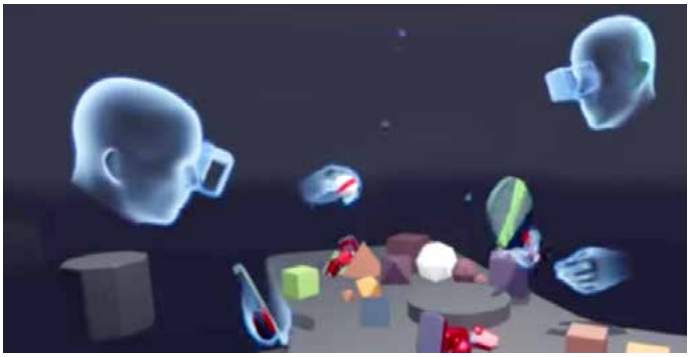
3.1.2 VR GUESTS

VR Guests are participants of the experience that are immersed in the virtual reality environment and interact directly with the Host. Their digital avatars are somewhat impersonal and minimalist, with the following components:

- Head - neutral appearance, possibly suggesting gender (male/female);
- Controller - for pointing to objects and making simple signs.
- Name Tags - for identification of their identities.

Fig. 7 shows an example of the visual representation of the VR Guests avatars.

Figure 7 - VR Guests Avatars.



Source: https://uploadvr.com/mindshow-creation-tool/

4.1.3 Story Characters

The Story Characters exist just on the Virtual Environment and are part of the base narrative content, such as a theater play. They have the following characteristics:

- Full Body Avatar - the characters are played by real actors and they are depicted by a digital humanoid in a style (i.e., realistic or cartoon) that is conducive to the nature of the story;
- Complete Motion Tracking - the movements of the actors are tracked by

sensors of a motion capture system and transferred to the characters.

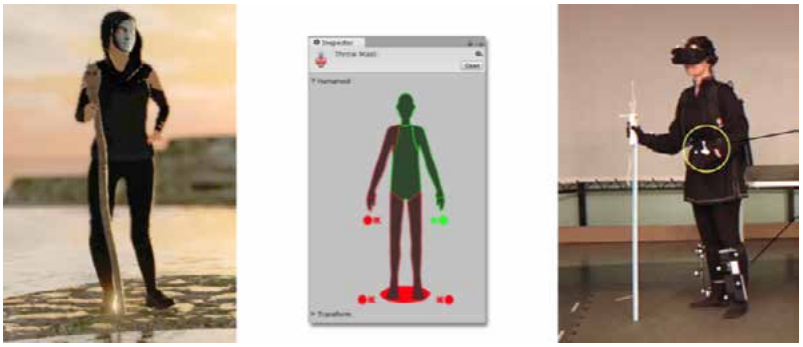
Fig. 8 shows an example of a digital avatar for the character Ariel of the Shakespeare's play *The Tempest*, interpreted by the actor Rick Yates. The avatar is modeled with the actor's physical proportions.

Figure 8 - Digital Character Avatar and Actor.

Source: VISGRAF Laboratory

Fig. 9 shows the motion capture set-up for the digital avatar of the character Prospera. The system tracks the actress movements using sensors at her feet, hands, torso and head.

Figure 9 - Full Body Motion Capture.



Source: VISGRAF Laboratory

The actor's performance for the narrative content is typically captured and recorded in pre-production and then played during the VR Tour. In this setting, the content can be segmented and played as separate clips during the VR Tour.

3.1.4 Regular Guests

Regular Guests are participants sharing the experience in a physical movie theater. They interact indirectly with the Host.

3.1.5 DIRECTOR AND STAFF

The director is the individual responsible for selecting the images of the VR environment that are projected on the cinema screen for the Regular Guests. Technical crew members operate the stages and help participants to set their VR equipment.

3.2. SPACES

The logical spaces where the experience takes place can be both Physical or VR Environments.

3.2.1 PHYSICAL ENVIRONMENTS

The Physical Environments are:

- VR Stages - virtual reality studios for the Host and VR Guests with all support for situated participatory interaction;
- Theater - movie theater with a cinema screen and a live microphone, respectively for the Regular Guests to view the experience and interact with both the Host and VR guests through an audio link.

Fig. 10 shows one of the VR Stages and Fig 11. shows an auditorium used as a Theater.

Figure 10 - VR Stage.

Source: VISGRAF Laboratory

Figure 11 - Movie Theater.

Source: VISGRAF Laboratory

3.2.2 VR ENVIRONMENT

The VR Environment is constituted by the static components of the virtual world. The Virtual Spaces are basically the "Sets" where the story takes place. Usually

the narrative calls for various ambients that correspond to different sets. These ambients can be indoors or outdoors, and include all elements that compose the sets, such as furniture and etc.

Fig. 12 shows an example of a Virtual Space, the Cell set of the play *The Tempest*.

Figure 12 - Virtual Space - Side View.

Source: VISGRAF Laboratory

Furthermore, the Virtual Space is structured logically in order to facilitate the Tour to follow the narrative. In that respect, the following is defined:

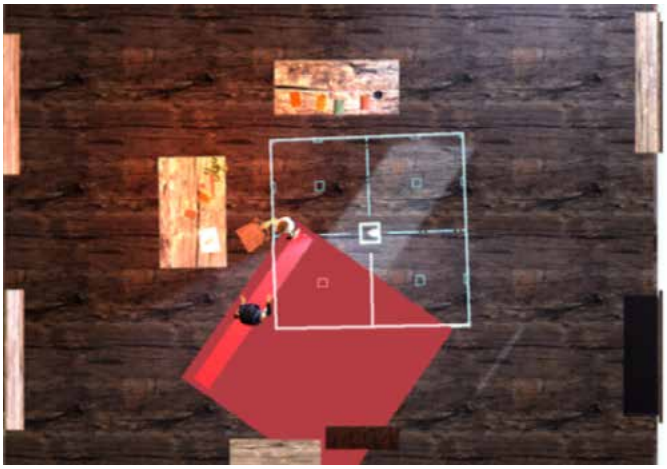
- Spots - location where some action happens in a segment of the story;
- Areas - parts of the Virtual Space that correspond to the VR motion capture physical area for tracking the VR Host and VR Guests;
- Paths - trajectories that are used to follow some action of the narrative.

During the Tour, for each segment of the story, the Areas are mapped to the corresponding Spot.

Note also that, the VR Host and VR Guests do not need, necessarily to be co-located. In this case, their Areas are different and usually mapped to disjoint relative locations in the Set.

Fig. 13 shows a top view of the Cell set with the Areas for the VR Host (in outline) and the VR Guests (in red).

Figure 13 - VR Areas for the VR Host and VR Guests.



Source: VISGRAF Laboratory

3.3 Virtual Elements

The Virtual Elements of the VR Environment are composed by the objects that are part of the Set and also other elements that are used for interaction during the tour. The interactive Virtual Elements can be of the following types:

- Cards - descriptive graphical signs attached to parts of the Set;
- Captions - used to show the textual representation of dialogues;
- Markers - indicate specific locations of the Set;.
- Active Images - used for videos and interactive animations;
- Lights - illumination controlled to highlight parts of the Set;
- Mechanisms - objects that animate and ca be interacted with.

Fig 14. shows an example of Cards, Captions, Active Image and Mechanism on a Virtual Space.

Figure 14 - Virtual Elements.

Source: https://vrroom.buzz/vr-news/immersive-arts/acute-art-opens-new-virtual-art-museum

3.4. PROGRAM

The VR Tour consists of a Program that is composed by three main parts: Preparation, Fruition and Follow-Up.

The Preparation takes place in the real world and accounts for the initial involvement of the participants with the VR Tour. It has the following steps:

- Registration / Data Collection - the potential participants first approach the VR Tour through the Web. They register for the experience and enter their personal data using the Internet Portal of the Tour;
- Reception - at the VR Tour site, the participants are welcomed by the technical Staff in order to give them instructions, take them to the VR Stages and hook up the VR equipment. Other participants may be directed to the movie theater.

The Fruition of the experience happens in the VR Environment. The Host and VR Guests use the VR Stages and the Regular Guests use the Theater. The experience can be structurally divided into three phases that happen in different shared spaces in virtual reality, as described below:

- Introduction - the participants are introduced to the story in a neutral space, such as the Atrium of an architectural complex;
- Scenes - the story develops through a sequence of situations that happen in different Virtual Sets;
- Conclusion - the end of the experience is a closing that returns to the Atrium, before the participants leave the VR environment.

After the Fruition of the experience, the participants can continue to explore the story remotely through the Web. The Follow-Up of the Program consists of a portal of the Tour that allows further interaction at home or using mobile and also connected to social media platforms.

4. Tour Script

The Tour Script describes the VR Tour. It contains all the content data and structure of the experience. It has also a computational representation with the mathematical models used by the procedural infrastructure.

4.1. Content

The Content of the Tour is composed by both the narrative and meta-narrative parts that fit together within a partial order. So, these components are as follows:

- Text - the basic text to guide the meta-narrative. It lists the main points that

refer the storyline. It is intended to serve as a basis for improvisation by the host;

- Story Clips - parts of the story that integrate each segment and are played during the Tour;
- Partial Order - non-linear dependencies between the different parts of the meta-narrative.

4.2. STRUCTURE

The Structure of the experience consists of Sequences, Scenes and Segments. A Sequence is divided into Scenes and a Scene is broken into Segments. So we can define:

- Sequences - main logical parts of the Tour;
- Scenes - parts of the story with spatial and temporal continuity;
- Segments - sub-parts of a Scene with a meta-narrative text and a narrative clip.

4.3. REPRESENTATION

The Computational Representation of the Script is a Graph that encodes a Finite State Machine used in the Exploration:

- Graph - the nodes represent states that correspond to segments and edges that correspond to valid transitions from a current node to other nodes;
- State Machine - controls the traversal of the Graph through time during the experience.
- Exploration - the active instance of an experience. It has a context that registers the current state as:
  - Unvisited Nodes (active);
  - Visited Nodes (inactive)

5. TOUR EXPERIENCE

The experience of the VR Tour is accomplished by the fruition of the meta-narrative of the story through the exploration in time-space of the faceted aspects of the content.

In that respect, the VR Host guides in this journey the VR Guests along the various paths inside the virtual reality environment, with the remote participation of the other guests (i.e., non-VR).

The relevant issues in the Tour experience are:

Navigation; Guided Participation; Interaction; and Cinema Presentation.

5.1. NAVIGATION

The navigation in the VR Environment is controlled by the VR Host that uses Teletransport to move between the Spots of different story Segments, as detailed below:

- Teletransport - the VR Host activates a Teletransport mechanism to take the VR Guests from one Spot to another. This transforms the relative locations of the Areas of both the Host and Guest to the Spot;
- Active Spot - the current part of the VR Environment being explored during the Navigation. It is associated with a particular story Segment.

Fig. 15 shows an example of Teletransport feedback. The VR Host indicates the location of the next Spot anticipating the move to VR Guests.

Figure 15 - Teletransport Feedback.

Source: https://vrscout.com/news/blade-runner-2049-memory-lab-cinematic-vr/

5.2. GUIDED PARTICIPATION

In each Spot, the VR Host uses meta-narrative techniques (i.e., improvisation, etc.) to describe to the Guests a part of the story that corresponds to the Segment being explored in the visited Spot.

Typically, this description is divided in three parts: first, the Host comments on the main points of that part of the story; next, the Story Clip is played; and finally, the Host makes concluding remarks.

During this process, the Host may possibly ask for input and participation of the participants. The mechanisms for this guided participation are as follows:

- VR Host - uses the controller for the operations: Go (teletransport); Play (clip); Emphasis (indication/highlighting);
- VR Guests - can interact using the microphone and the controller for audio communication and pointing to objects, respectively.
- Regular Guests - can interact remotely using group microphone.

As a result of this structure, the experience is similar of a visit to a Wax Museum,

in the sense that the participants go to different locations of the VR Environment where a Scene is depicted. The Story Characters are static as wax statues in the museum. But differently from the real museum, during the VR experience magic happens and the characters come to life to enact a part of the story.

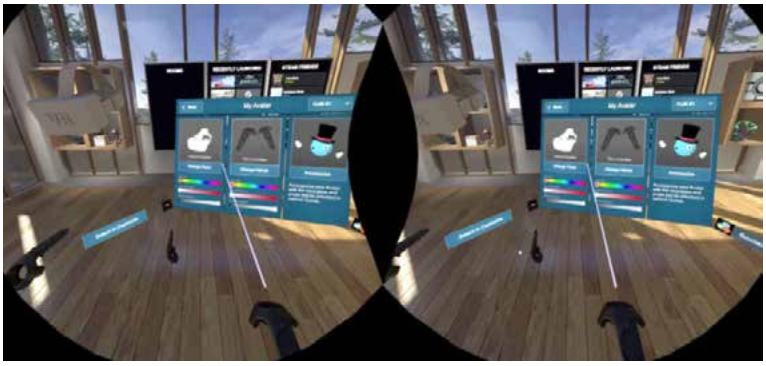
5.3. INTERACTION

As mentioned in the previous subsection, both the VR Host and VR Guests can interact with the Set using the VR Controller as follows:

- Highlighting - the Host has the option to highlight / activate by pointing with the controller to objects;
- Pointing - the VR Guests can only indicate with the controller to locations in the Set for visual communication.

Fig. 16 shows an example of the laser pointing effect using the controller.

Figure 16 - Laser Pointing.



Source: https://www.vrheads.com/how-change-environments-steamvr-home

5.4. CINEMA

The Regular Guests that are not immersed in the VR environment participate of the experience through a Cinema presentation, in the spirit of VR Kino+Theater. In that context, the following mechanisms are used.

- Cameras - programmed to show the views of the Virtual Set to the Regular Guests. The can be controlled by the Director or automatically;
- Microphone - the Theater is equipped with a microphone in front of the movie screen for use by the Regular Guests to communicate with the VR participants.

6. CASE STUDY: THE TEMPEST VR TOUR

In order to demonstrate the concept of VR Tour and test the system we are going to use the experiment *The Tempest* based on the Shakespeare's play.

We selected from *The Tempest* experiment two Scenes to compose our narrative as a cut of the story. The scenes are taken from Act I of the play.

The Program for the experience follows the canonical structure discussed in Subsect. 4.4 with the Scenes of the narrative, plus an Introduction and Conclusion.

The Introduction and Conclusion Segments take place in an Atrium. This Set is an virtual room with hexagonal form, where each wall has a poster related to *The Tempest* play. Fig. 17 shows the Atrium virtual set.

Figure 17 - Atrium.

Source: VISGRAF Laboratory

The first Scene is a dialogue between the Characters Prospero and Miranda that is situated on Prospero's Cell. Fig. 18 shows the Cell virtual set.

Figure 18 - Cell.

Source: VISGRAF Laboratory

The second Scene is a dialogue between the Characters Prospero and Ariel that happens in a Clearing in the Island where the story unfolds.Fig. 19 shows the Clearing virtual set.

Figure 19 - Clearing.

Source: VISGRAF Laboratory

The visual look and atmosphere of the play is due to light design. As such, a great effort was invested in establishing the appropriate mood for each ambient.

In the Cell the goal was to achieve an intimate environment. For this we resorted to Volumetric Lighting coming from the window and by a warm Lighting from the candles. At the Clearing, the plot called for both day and night illumination. This was achieved using Sky Light Mapping. For the night illumination a campfire was also created.

CONCLUSIONS

In this paper we introduced VR Tour, a platform based on the technological infra-structure of Kino+Theater that exploits concepts of Situated Participatory Virtual Reality and Live 3D Digital Cinema.

The platform has a foundation in the following concepts: *Meta-Narrative* – The content is associated with a story. The exploration of this content uses meta-narrative techniques to present the story; *Story-Content* – The the story has a narrative structure, that can be fictional, such as a theatre play, or factual, such as a documentary; *Navigation* – The story takes place in a space. The environment is explored through navigation in this space; *Guided Tour* – The exploration is guided by a "host" that directs the participants ("guests") though their journey; *Participatory VR* – The guests experience the tour in a shared virtual reality.

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