

DESIGN RESEARCH SEMINAR

**Storyboarding and Animation Techniques
for Storytelling in 360 Degrees**

Submitted in the partial fulfilment of the requirements of the degree of

Master of Design

By

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Guide:

Prof. Jayesh Pillai



**Animation and Film Design
Industrial Design Centre**

INDIAN INSTITUTE OF TECHNOLOGY, BOMBAY
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APPROVAL SHEET

The Design Research Seminar Project has been approved for the partial full-filment of Master of Design Degree in Animation. The project entitled,

“Storyboarding and Animation Techniques for Storytelling in 360 Degrees”

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Approved by:

**Prof. Jayesh Pillai
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Signature:

Date:

Place:

DECLARATION

I declare that this written submission represents the work done by me, summarized in my own words. Wherever other images and texts have been included, they have been adequately referred to their original sources.

I also declare that I have adhered to all principles of academic honesty and integrity and I have not fabricated or falsified any of the data/ facts/ contents in my submission.

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ABSTRACT

Virtual Reality as a medium gives the user an immersive experience of the story by letting the user enter the virtual world in which the story unfolds. The way in which the VR experience indulges the audience depends on how well planned the sequences are within the story. A poorly constructed VR story lets the user move in all directions, thereby missing the story completely, which acts against the intended objective of the VR narrative. A proper storyboarding of the virtual reality video or game is, thereby, necessary to give the audience the experience they would love.

This paper sums up the planning processes that were tested out while designing a VR 360 video and the storyboarding techniques used to work out the story. The different approaches towards a successful storytelling through VR are listed out.

Keywords:

Storytelling, VR, HMD, Storyboard, 3d, Maya, Domemaster 3d

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INTRODUCTION

Virtual Reality has been receiving a widespread audience not just in commercial scene, but also from household consumers. The immersive experience that the medium can offer has accelerated the growth of the same in visual storytelling, let it be live-action or animation.

The use of Head Mounted Display (HMD) for the viewing purposes have the constraint of limiting the audience within its field of view and anything that happens in the story has to be experienced by the viewer in real time and with realism and it should ensure that the audience should not lose track of where to look so that the action is never missed out.

This can be achieved by proper storyboarding.

The VR story progress is different when compared to a normal short film or movie. The audience's presence and interaction defines the next action in the story if it is an interactive story, and if it is a 360° video, the audience need to know where the action is going to take place, so that the entire story is unfolded without confusion.

The way storyboard is done for a VR story is not the same as that being followed for a regular frame based movie. The storyboard artist needs to take utmost care about the entire 360° of the environment and ensure that the whole set is present and scripted. The actions and triggers should be carefully planned before executing the story. This paper deals with the studies conducted on the topic of Storyboarding and Animation for VR.

MOTIVATION

Once a 360° VR movie is created and given to the audience for testing, the analysis of their way of viewing the story can determine different drawbacks of the experience.

Analysis of an existing 360° video which was non interactive, but immersing, done with 20 plus users have revealed that each individual responds differently to the visual cues hidden within the story.

Some people may completely avoid those cues voluntarily or accidentally, while others follow the cues. Analysis of how different users navigate through the story helped visualize a general trend in the navigation process and which needs to be incorporated in all future virtual reality movies. The lack of uniform viewing experience among a small group of 20 plus people motivated us to reimagine the way the story unfolds in VR, so that every tiny bit of clue is captured by the audience and they never miss out on any action that takes place.

OBJECTIVES

The objectives of this research project was to study, analyse, explore and to propose methods for storyboarding and animatic for 360 degree surround storytelling experience, other than conventional methods of storyboarding and animatic, and to understand the animation techniques and workflow for making 360 degree videos.

The aim was also to make the production phase of the story more easier by thoughtful planning in the preproduction stage, so as to reduce the chances of reducing the immersive effect.

RESEARCH

The first step towards research was analysing the pattern of user interaction with existing VR videos and how users interpret what is going on within the HMD, and how they involve themselves in it. A sample collected from over 20 plus participants as part of another project, was utilized for analysis, and it was found that more certain things were common:

- As long as the environment is steady and non moving, the user focusses on anything that is moving
- The user indulgent is more clearer if the objects are closer to him
- People rarely look at 180° angle, i.e. they rarely look back to view things unless there is an audio clue which says so.
- Sound plays a major role in indicating where to look.
- When the background changes, most participants seem disoriented and are no longer having any clue of what to do or where to look
- When time of the day changes, i.e, from day to night, user gets confused as well
- Transitions doesn't work well with VR videos unless it happens with a cue.
- Text and subtitles are missed by many when they are put all around in a 360° canvas.
- Some people tend to remain stationary despite the action being played out in a different corner of the virtual screen.
- Too many moving parts in the video also tend to confuse the audience as to where to look.

Based on these observations, we came up with certain approaches towards creating a successful storyboard technique that doesn't confuse the audience, and also give periodic cues.

Use of storyboards

Storyboards are the key components to any movie, let it be live action or animation. A well sought out storyboard eases the work shooting the movie as well as all the production and post production tasks. A well written script and a detailed storyboard can ensure that the movie creation process will go smooth and without hurdles.

However, the story is different in a VR based environment. Even though script and storyboard is a must, it is even more important to make sure certain aspects of the storyboard stand out compared to a traditional way of storyboarding.

Virtual Reality is all about immersiveness and presence. How the audience react to his surroundings can be determined by proper planning. In VR, storyboard doesn't contain a panel. All the happenings are captured simultaneously.

For example, if the main action is a boy walking in a park, the side actions like butterflies flying behind the viewer, cars moving far away on the street, everything has to be well planned out before production starts. Filming in live action is a tedious job and takes many turns to get it right. However, filming for animation is a whole different story. The control that can be attained in an animated short VR film, is more compared to its live action counterpart. Certain aspects of storyboarding for VR and frame based video can be compared, as below.

Comparison 360 Degree Video and Frame based Video

Virtual Reality videos can be compared to traditional form of video, which has similarities but with certain aspects of difference as well.

FILMING AND PRODUCTION

Traditional frame based video follows a set of rules from planning phase to its post production. The process is almost similar in VR based video, however certain aspects like set design, environments, extra characters on screen and sound design varies greatly in VR based movie.

In a VR based environment, everything matters. If it is a live action video, even the crew and bystanders matter when it comes to shooting the video, and none of them should interfere with the video production.

Eg: While filming a 360° solo music video, it should be noted that every single shot should be such that only the actor is the participant and not even the camera crew is on the scene.

It is unlike the traditional video where the crew is on the set.

USER INTERACTION / PRESENCE

Traditional frame based video, unless made interactive, is a linear flow of the story. The story unfolds itself to the audience within a stipulated time. If it is interactive, the story changes according to the user choice.

However in a VR based story, interactive or not, the user is immersed within the story from beginning to end, and he gets to feel what it is to be inside a movie.

Eg: Invasion 3D - short film.

Especially in the case of an adventure or a horror film, VR gives extra feel to the audience once they see everything happen around them.

PLANNING AND STORYBOARDING

The planning and storyboarding for VR and traditional film are different considering the fact that in VR, every little aspect of the et should be taken care of and no extra element should get involved in the film making that the story doesn't need.

In case of animated VR story, every cue has to be made in such a way that one cue redirects the user to a scene and never disorients him.

TIME

Time involved in making VR movie is longer than that of a frame based movie, considering the fact that the post production stitching is time consuming, be it animation or live action.

Adding 3d audio into the scene and making it truly realistic also needs precise timing, which adds to the production time.

LIGHTING

It is important to light all the scenes in the case of both frame based and VR movie, but the former has one panel of a frame at a time, while the latter has the entire dome of view that has to be lit.

In animation, specifically 3d, the lighting can be manipulated as needed, but in live action VR film, utmost care should be taken to light all the necessary elements (mainly natural lights as artificial lights tend to obstruct the view and end up appearing in the story).

POST PRODUCTION AND COMPOSITING

Post production for normal films takes less time compared to VR as the latter requires careful stitching of individual camera angles most of the tie. But with the advent of more advanced 360° cameras, the time spent on post production has been brought down to a bit as the stitching process can be automated. Also more sophisticated softwares have entered the market that makes the post production in VR much smoother.

EASE OF ACCESS

Normal films can be screened in theatres, sold as hard copies and watched on screen, whereas VR films requires dedicated devices like the Head Mounted Display (HMD) which comes in different standards. Starting from Google Cardboard to Oculus Rift and Samsung head gears, the user experience varies depending on the available device.

A fully active VR interactive film can never be experienced in the same way in a Google cardboard as in a Oculus HMD.

AUDIO INFLUENCE

Audio plays a very important role both in traditional and VR based films. But the latter has more use with sound as, apart from moving the story forward and giving the ambience and clarity, sound is used as cues in a VR based story to tell the audience where to focus at, for the next shot.

Eg: A sound of train approaching from behind can be given prior to the appearance of the train, so that the user can turn back and look when the train actually comes. Obviously 3d binaural sounds increase the immersive experience to a different level.

USER FEEDBACK DETERMINES A LOT

Ultimately the user is the one who should experience the full effect of the movie. A normal film can be rated by the users by the level of entertainment that they got by it, but for a VR film, the way they navigated through the film, the physical stress they would have got while trying to focus on something, the mental satisfaction they obtained, their fear and anxiety while viewing the story, everything can be included in the feedback, which can make the next VR film much more user friendly.

ANALYSIS OF EXISTING METHODS FOR STORYBOARD

Virtual Reality and 360 degree videos being a new medium of film making, still there is no standard format of story boarding. Different studios, filmmakers, designers have their own approach for this based on what they are making. We analysed some of the existing methods, which has been discussed below. No method is correct or wrong it just all about clearly it can convey one's ideas to artists or people involved in the process.

Panoramic Storyboards

In this method 180 degree panorama style boards are used, where both the right and left ends indicates the position behind the user / camera. Below is an example of such storyboard, from a commercial project by Rudi Liden.



Fig 1: Storyboard - VR and frame based

Courtesy: <https://famousframes.com/blog/view/the-virtual-reality-of-storyboards>

Storyboards based on field of view

This technique of storyboarding is based on ergonomics data of user's field of view from HMDs. The combination of field of view and distance data are put together into graphical form over which storyboarding is being done.

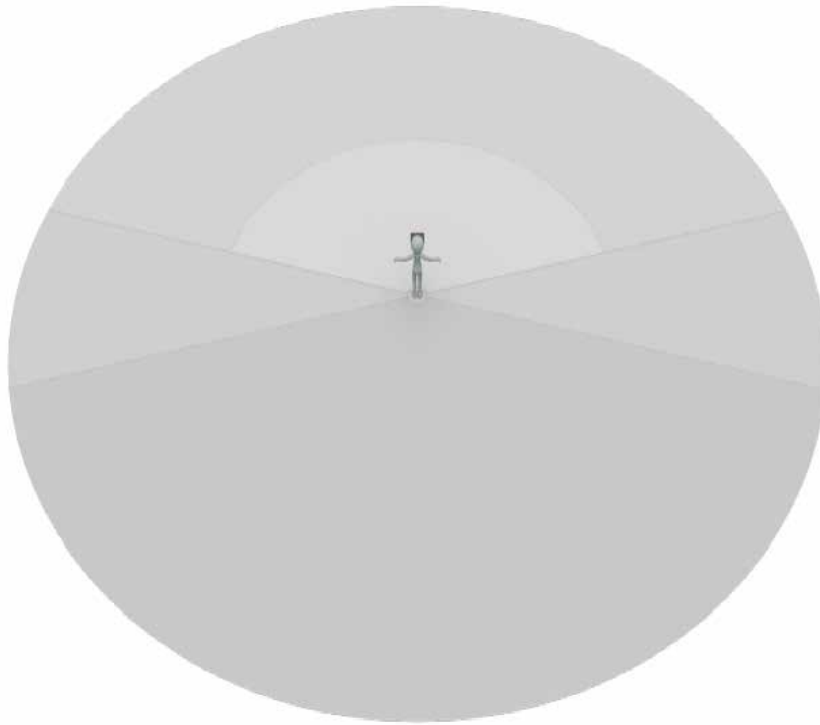


Fig 2: Storyboard - based on field of view

Courtesy: <https://virtualrealitypop.com/storyboarding-in-virtual-reality-67d3438a2fb1#.7a9in81se>

Unfolded cube

In this method of storyboarding each storyboard panels are considered as a unfolded cube. Thus all six faces of the cube representing the 3D space in 2D form. This format provides the flexibility and workflow of conventional storyboarding by treating each views (front, back, side, top and bottom) as a separate frame.



Fig 3: Source: <http://www.opteragroup.com/ar-vr-storyboard/>

Nine frame spherical storyboards

It is also a modified version of traditional storyboarding and representation of 3D environment in 2D plane. It also based on the method of representing all possible views of the user into separate frames within a single board. As per the demonstration of this particular method by Scott Ownbey (CEO at AnimaticmediaVR), it seems as simplified representation of an unwrapped sphere. Like the previous technique of unfolded cube which uses 6 frames for single board, it uses 9 frames for a single board.

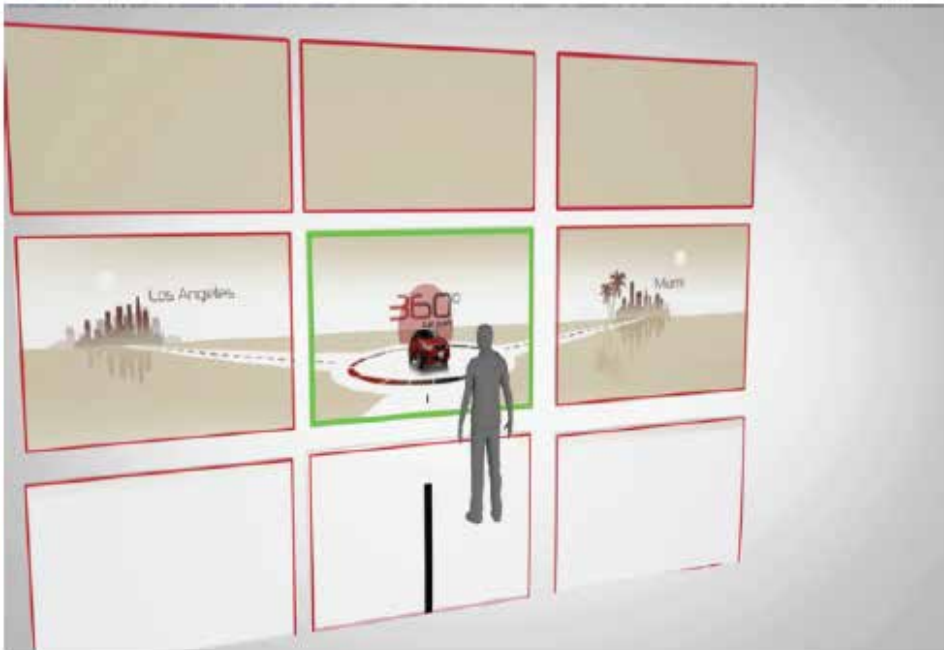


Fig 4: Courtesy: <https://www.linkedin.com/pulse/how-storyboard-virtual-reality-360-video-scott-ownbey>

All above mentioned methods are created by some studios / individuals for projects they are undertaking. While we approached our storyboarding we found certain limitation and also some good points in each methods which we can adapt in our project. Its need to be keep in mind that storyboards are suppose to be used by artists and members associated with the project, not the end user. Thus focus group should be the team members not the user, also it is likely that the focus group will be already aware of the concepts and script, so storyboard panels are not something they have never heard of, it's just the visual representation of the script they already know about.

Among all four method we decided to begin with the unfolded cube, as it represents the 3D environment with less number of frames, like the nine frame storyboard also represent the 3D space but it has more number of frames also it does focuses on the back side of the user. It is not necessary that events / actions are never going to happen behind the user or user will never look back. Although back side has low priority in respect to field of view of the user, there are chance that out of curiosity they might look back.

Another reason for choosing the unfolded cube is that, how appropriate your storyboards are to make them into an animatic video before making a prototype.

STORYBOARD

In storyboarding for VR there are certain decisions are need to make before starting storyboarding, like it's format (interactive / non-interactive), camera position and movement, gaze control, effects and sounds. Making a plan for all of these save lots of time while prototyping the scenes. In our case it is a non-interactive narrative with three scenes and a fixed camera position.

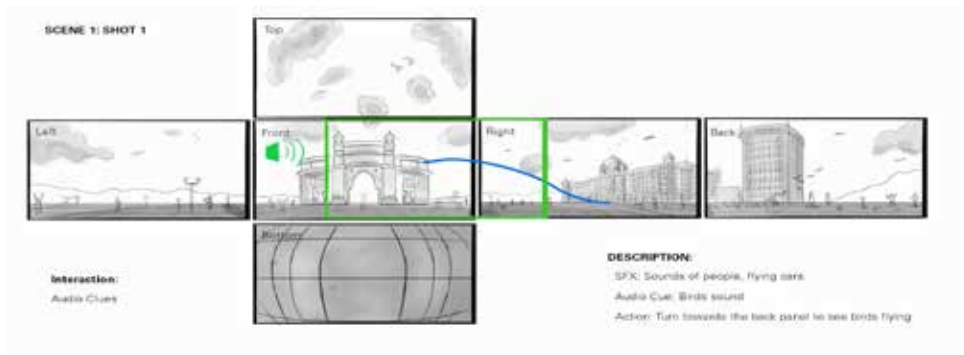


Fig 5: Storyboard - Scene 1

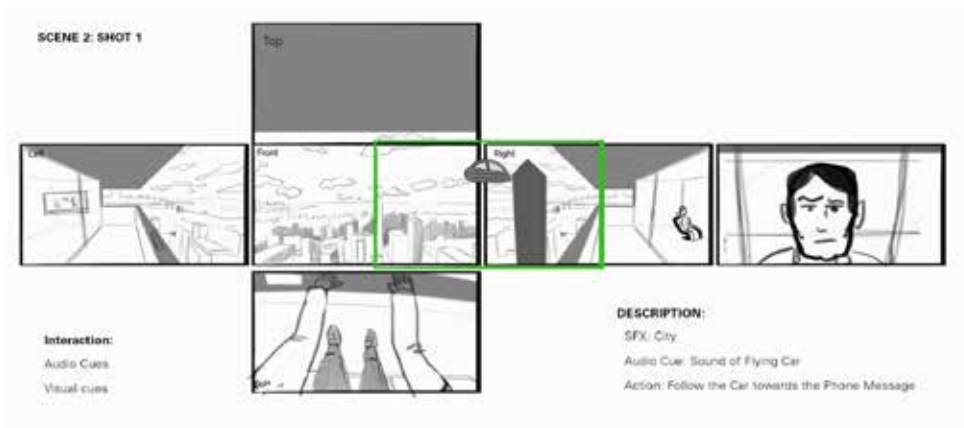


Fig 6: Storyboard - Scene 2

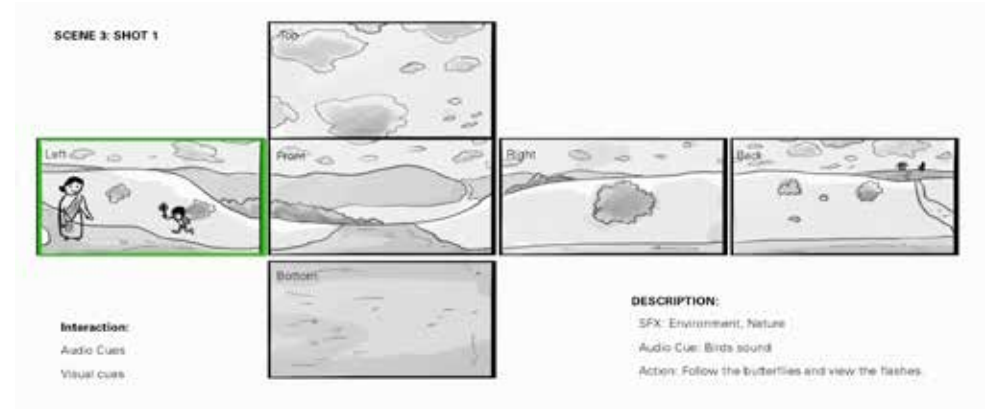


Fig 7: Storyboard - Scene 3

ANIMATIC VIDEO

For animatic video we used the same storyboard panels where we have used a marker to point out the desired area of focus. Also there are indications for direction of voice. This step is very help full to figure the timing for each actions. Which saved lots of time in later stages of prototyping and animation. It also helped us to planned out the animation which saves the overall render time

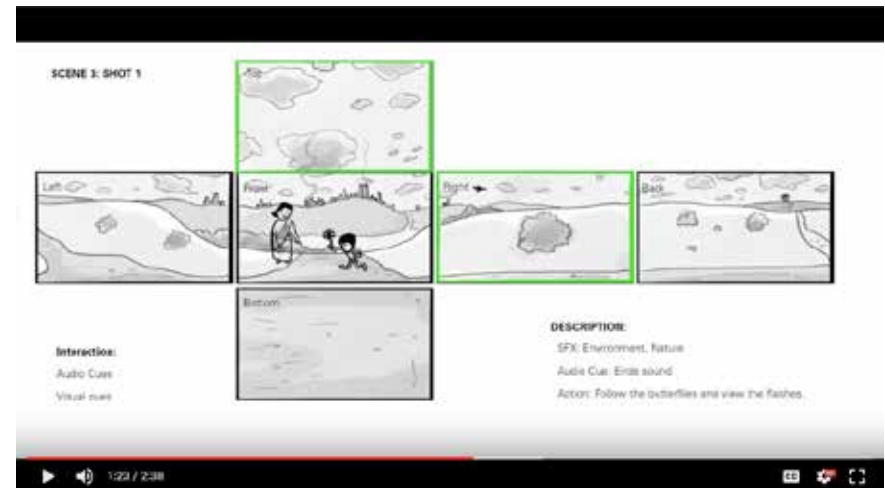


Fig 8: Animatic based on user viewing

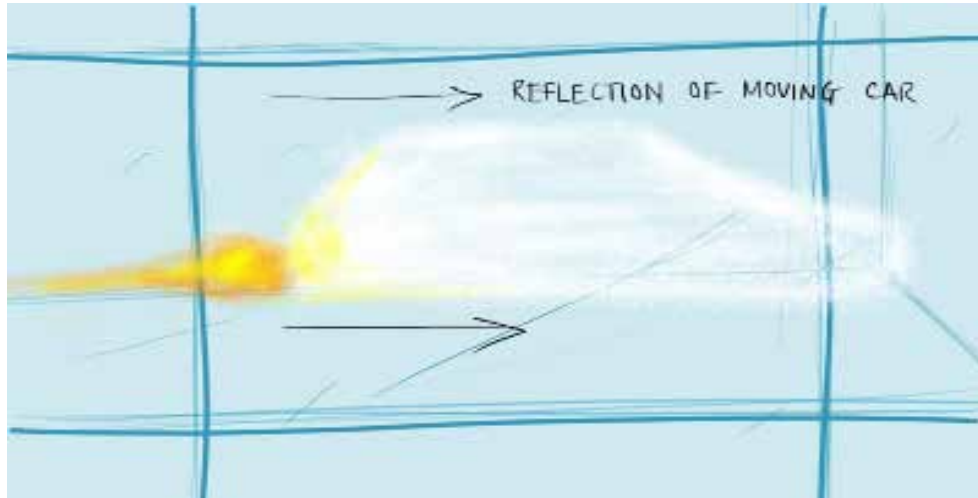


Fig 9: Assuming user is looking at back window, while the car passes (Future City Scene)

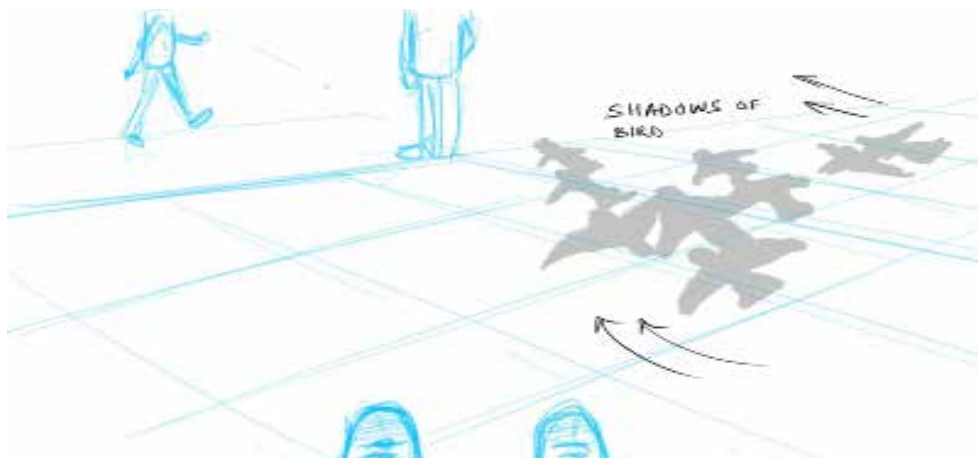


Fig 10: Assuming user is looking at back window, while the car passes (Future City Scene)

GAZE CONTROL

Gaze control is very important in VR storytelling. There are many ways of doing that, through visual effects, sound effects and possibilities are further more if it is in interactive format.

If we assume that at a particular instant the user will NOT going to look at where they were to, following are certain proposed ways through which visual cues can be given. Cues are not very forceful, so that they looks like part of the narrative. Certain places has been left clueless, as per our opinion missing out certain stuffs in first watch and discovering in second time, is unique about 360 degree videos.

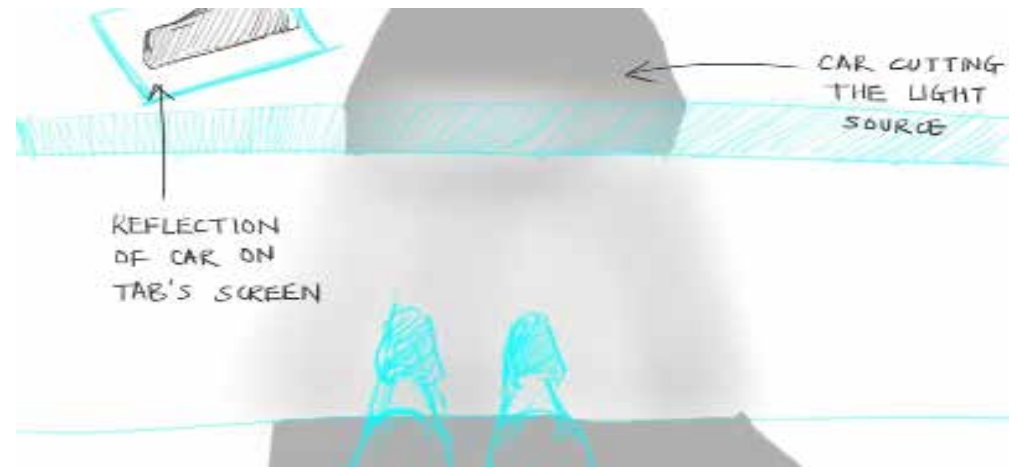


Fig 11: Assuming user is looking down while car passes (Future City Scene)

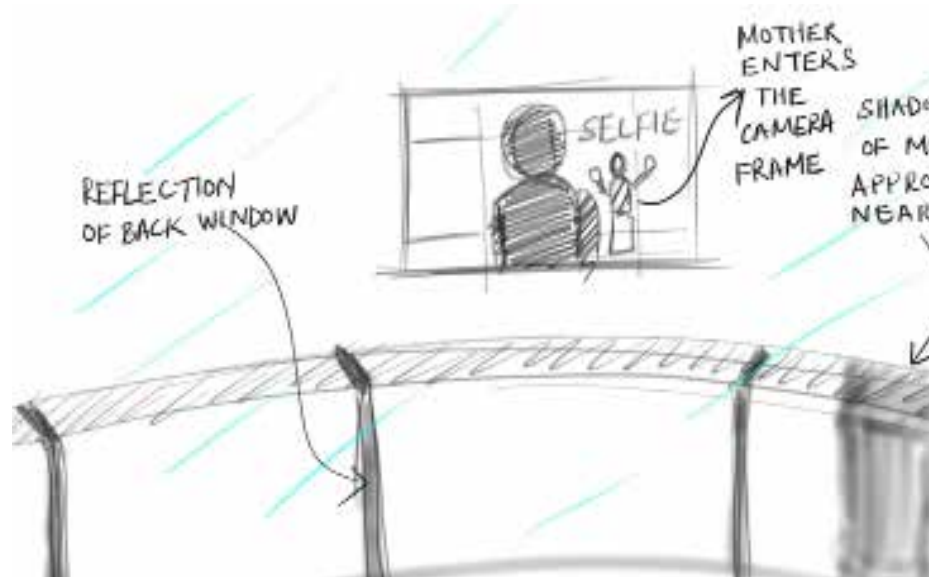


Fig 12: Assuming user is looking at front while Mother comes near the window (Future City Scene)

SCENE BLOCKING

Fig. 13 shows the entire workflow of the project. The storyboarding and animatic stage was followed by 3D blocking of the scenes. Initially the scenes were set up quickly using basic primitive shapes like cubes, spheres, cylinders and camera positions were locked. Once the blocking is over it was very convenient and quick to check and adjust the depth of field, scale and timing for final animation. It can be done with final props and characters also, but using a blocked scene saves the overall render time



Fig 14: Rendered image of a blocked scene

PROCESS

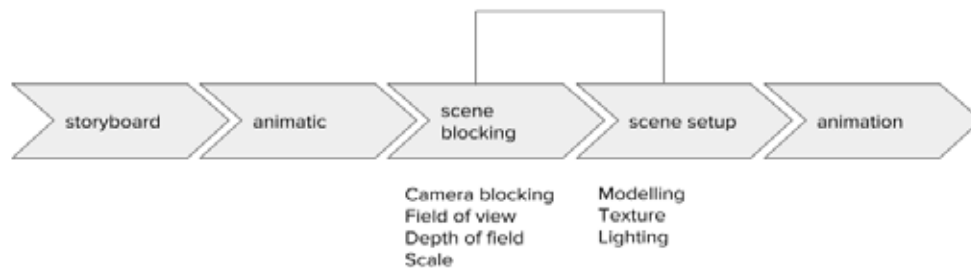


Fig 13: Process flow chart

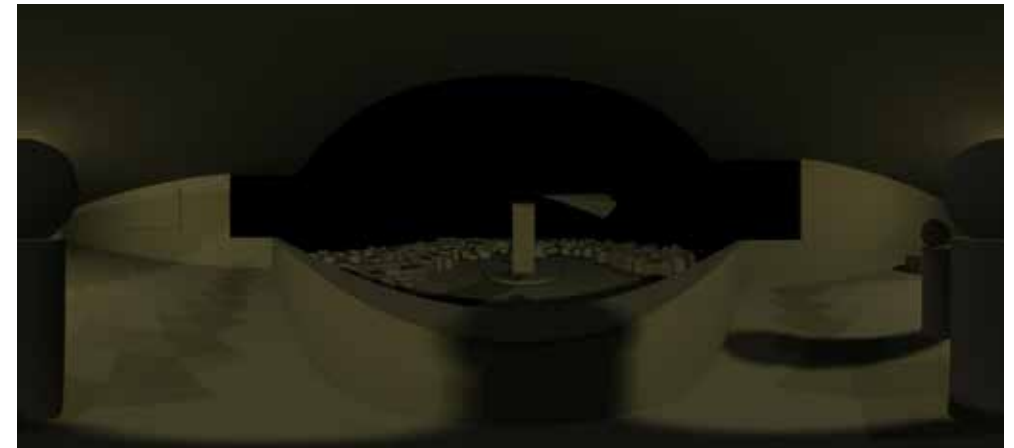


Fig 15: Rendered image of a blocked scene



Fig 16: 360 render of actual scene

PRODUCTION PROCESS

The Pre production phase of the animation ended when the timing was finalised, and the animatic was frozen. The next stage was the production phase. Modeling, Rigging, Compositing, Animating, Rendering. These were the processes involved in creating the final film.

The entire animation process was carried out step by step using Autodesk Maya, and a third party plugin called DomeMaster 3D.

Modeling:

The individual props and characters were modeled in low poly, using Autodesk Maya, and Blender. The textures were then applied to the models to give them a realistic look.

Some models were also downloaded from free download websites so as to reduce the effective time spent on modeling.

Rigging:

Certain characters on screen were animated, which were rigged using basic rigging mechanisms.

Eg: Pigeons, Humans.

Compositing:

Compositing within 3D was done by fixing the camera position and adding lights, and extra environmental features like grass, props etc.

Animating:

Animation involved in the process was carried out in such a way that visual cues were given at the end of each scene so that the audience gets an idea where to look at.

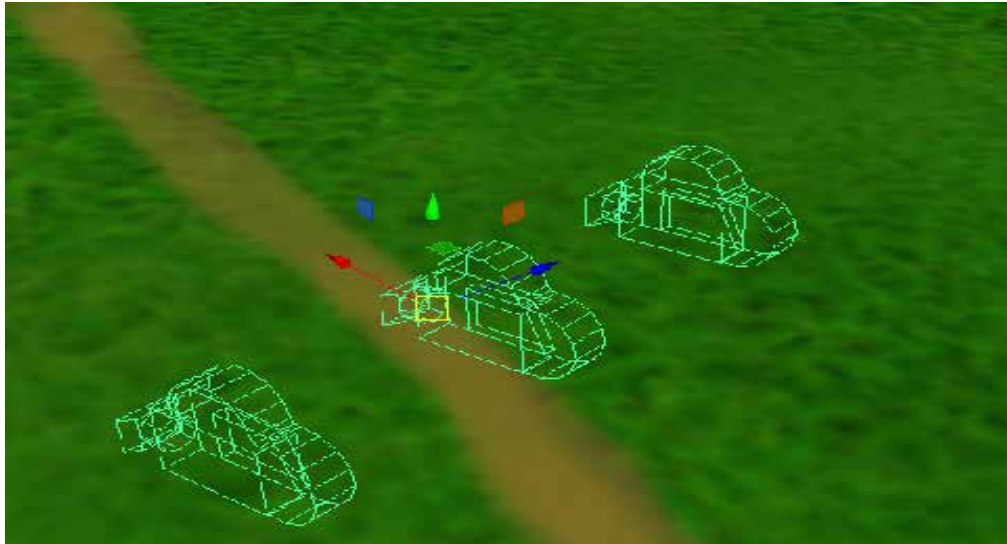
Birds were animated using Particle Flocker in Maya, and a single bird was animated and duplicated multiple times using Particles in Maya. Human characters were given minimum animation, especially in the initial scene. Bipedal and Quadruped rigging were used to rig the characters. Animated water was from the stock Maya library, taken from Visor tab of Maya.

Rendering:

This was the hardest part in the entire process. Rendering was carried out using Mental Ray plugin for Maya, and the stereoscopy was achieved using a third party plugin called DomeMaster 3D.

DomeMaster 3D:

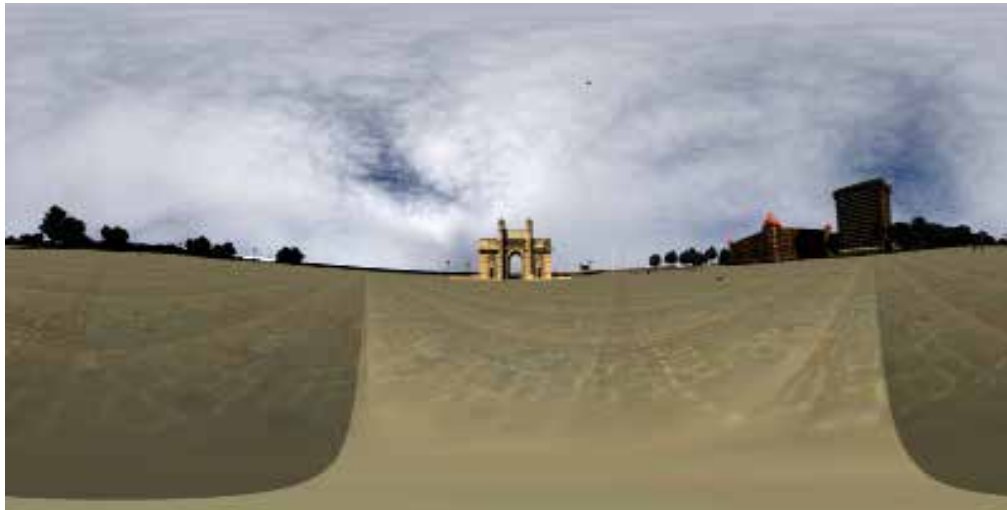
The purpose of DomeMaster 3D does is to create three attached cameras, namely Left, Right and Centre, with which stereoscopy is achieved. While rendering, there will be two images for every frame that will be rendered out, one Left and one Right image, which has to be composited during Post, to obtain the stereoscopic effect.



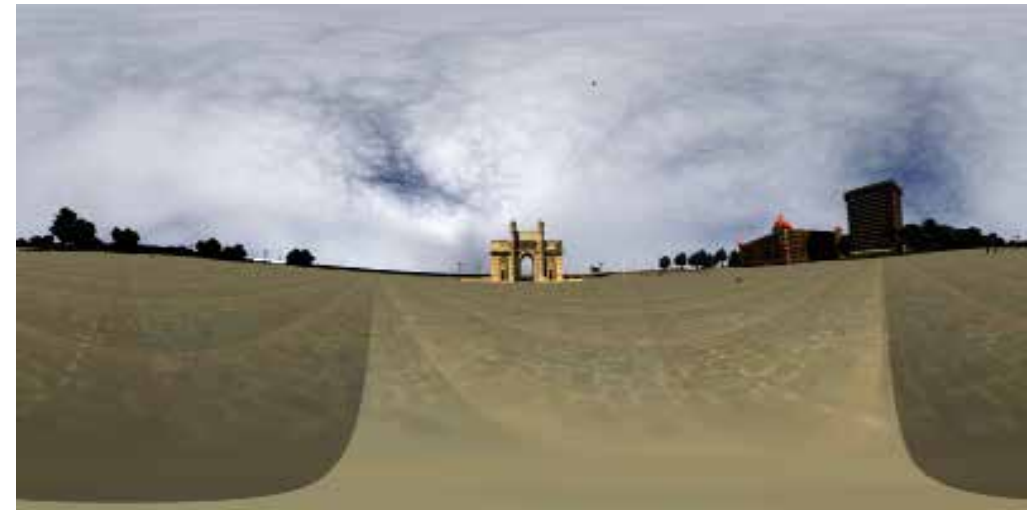
(A)



(B)



(C)



(D)

Fig 17: (A) DomeMaster Cameras, (B) DomeMaster Scene setup, (C) Domemaster output - Left, (D) Domemaster output - Right

CONCLUSION

360 degree storytelling is a new medium in filmmaking, thus there are various factors which enhance as well makes the process of filmmaking a bit challenging. Over the years filmmaking is being dominated by the traditional method (frame based) of filmmaking, which has created a kind visual language both among the creators and audience. Breaking those convention and overcoming the challenges is important. During the course of this research project following were the issues which came across.

- Creating Depth
- Scale and Distance
- Gaze Control
- Rendering Time
- Compositing
- Hardware & Software issues
- Scene to Camera Scale Ratio

Depth of field and Scale & Distance is very important factor as it makes the entire scene more believable and real. In case of non-interactive storytelling scale and distance can be faked without making every object as per scale, also the Scene to Camera Scale ratio affecting the scale and depth. Gaze control is also well known issue with 360 videos. It depends on how you draw the attention. It should be keep in mind that “controlling” doesn’t always define drawing the attention of the user, sometimes distracting from them from what they are actually focusing in may be helpful.

Rendering time is the most major issue with 3D 360 degree animations as it heavily determines your entire production time. Since here we used to have two images (right and left) for each frame, that is for a 24 fps footage it will have 48 images for a second’s footage instead of 24.

That means the render time is double the time for a frame based video. Thus it is highly recommended that everything should be finalised in blocking stage before going for final rendering.

Compositing for 360 is a bit tricky as it has to be done for both right and left images and needs to be matched. However it is not impossible but have to be done carefully with a eye to perfection so that it cannot be identified while viewing in a HMD. In our project few of the things, like fake shadows & lights using solids, masking and compositing render passes from Maya have been done in post production using Adobe After effects.

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