Deliverable

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D4.2 Pilot Execution Report

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Abstract: This deliverable reports on Task 4.2 pilots. The outcome of this deliverable is a description of the pilot 1 execution for the offline produced content scenarios within the ImmersiaTV project.

REVISION HISTORY

Revision	Date	Author	Organisation	Description
0.1	1/12/2016	Luk Overmeire	VRT	Table of content
0.2	15/12/2016	Marieke Lycke, et al.	VRT, et al.	First draft of the deliverable
0.3	21/12/2016	Heritiana Ranaivoson	imec	Review

EXECUTIVE SUMMARY

This deliverable describes how the pilot of the ImmersiaTV project was conducted resulting in a documentary demonstrating the content.

In the first version of the deliverable (M10), we report on the first pilot within the project which took place between May 2016 and December 2016 and we discuss the derived insights and lessons learned.

This document lists both content, used tooling and evaluation activities of the pilot. The content section first describes the scenario of the pilot and how it was transformed from pre-production to post-production into the final demonstrator. Special attention is given to the impact of the ImmersiaTV concept to each step of the production. Next, the tools that were used during the pilot are presented. Finally, the activities to evaluate the pilot, from the perspective of the software tools as well as the developed documentary, are introduced.

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LIST OF ACRONYMS

Acronym	Description
GOP	Group of Pictures
HD	High-definition
HMD	Head Mounted Display
IBC	International Broadcasting Convention
MPD	Media Presentation Descriptor
MPEG-DASH	Moving Picture Expert Group - Dynamic Adaptive Streaming over HTTP
NEM	New European Media
PhD	Doctor of Philosophy
Pr	Adobe Premiere Pro
UCP	Universidade Católica Portuguesa
UHD	Ultra-high-definition
VR	Virtual Reality
WP	Work Package
XML	Extensible Markup Language

1. INTRODUCTION

1.1. Purpose of this document

This deliverable documents in detail the execution of the first pilot within the ImmersiaTV project as described in Task 4.2: pilots. The pilot of WP4 was executed based on the insights and requirements acquired in Task 2.1: end user requirements and Task 2.2 : professional user requirements, and the scenarios during the content ideation process in Task 2.3.

1.2. Scope of this document

The WP4 pilots are a vital part of the ImmersiaTV project. The aim of this deliverable is to describe in more detail the execution of pilot 1: pilot scenario, specific planning and preparation, used production infrastructure and tooling and pilot evaluation.

This includes the following sections:

- *Pilot content:* in this section we describe the content produced for pilot 1 and elaborate on how the content production was performed

- *Pilot tooling*: describes the different tools and components used in pilot 1

- *Pilot evaluation*: describes the different user evaluations executed for pilot 1

1.3. Status of this document

This is an intermediate version of D4.2 with delivery foreseen in M10. Next versions of this document will be delivered in M19 and M29.

1.4. Relation with other ImmersiaTV activities

The relationship between Task 4.2 and the other WP4 Tasks and relevant WP2 and WP3 Tasks is shown in the figure below.
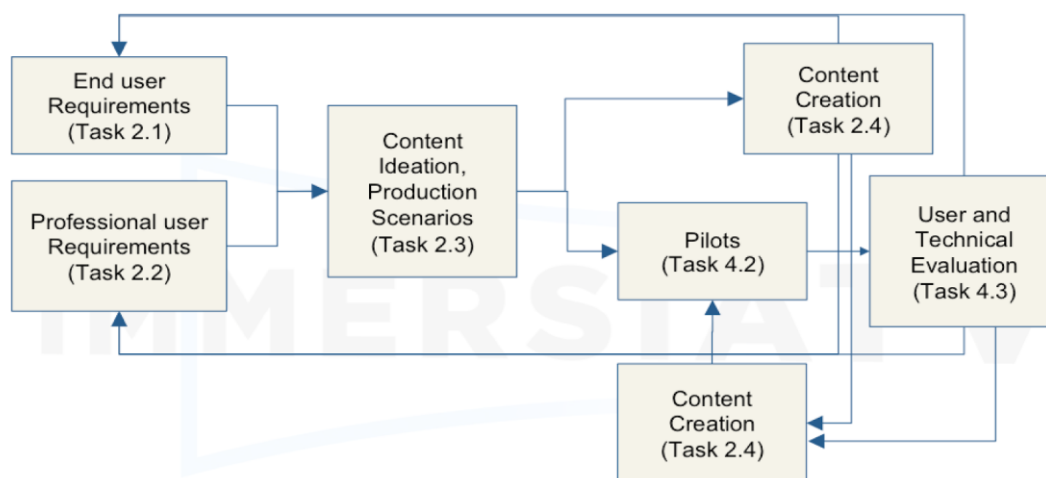

Figure 1: Relationships between different tasks

2. PILOT 1 CONTENT

This first ImmersiaTV pilot focuses on the creation of offline content for head mounted display (HMD) television sets and second screens. This section will describe the content of this first pilot, starting from the pilot scenario (2.1) to its execution (2.2). In 2.3 the lessons learned are set out.

2.1. Pilot scenario

Pilot 1 is described as an offline scenario documenting the daily life of a young football player and his family, all this done using immersive content and regular directive video. To produce a consistent story, it was necessary to prepare a script taking into account the additional opportunities and alternatives brought by the combination of multiple types of content and devices. This was also critical during the edition process.

In the documentary, we follow the steps of David, a young Portuguese athlete who joined Dragon Force, FC Porto's football school, to pursue his dream of becoming a successful football player. During his busy, hard-working days, we will meet his family, his friends and the dedication of this 14-year-old dreamer. Shot in immersive technology, "**Dragon Force: The Making of Future Heroes**" gives the audience a literal inside view of what it takes to become one of the greatest football players.

The full scenario of the first pilot is given in annex I. Just like the final cut of a movie does not 100% correspond to the shooting script, also the prepared scenario was subjected to revision and modification in the post-production process. As a consequence, the actual pilot differs from this script.

2.2. Pilot execution

The first pilot was executed in a traditional three-step process used in filmmaking: pre-production, production and post-production. In every step decisions had to be made that impacted the scenario and the final result. Since the combination of 360° and 2D video is relatively new, all steps were handled with extra care, trying to learn more about what the Immersia concept is and what it can do.

Pre-production
During pre-production we had to decide what shooting 360° and 2D at the same time means. Usually, everything is done for the sake of what's in front of the camera since the remainder behind the camera is unseen**.** In this specific 360° case, the complete surrounding is captured by the camera. Therefore, a couple of important points had to be considered:
1. How to synchronize between 360 and 2D cameras.
2. How to take full advantage of a shooting space, or set, in order to: hide the 2D cameras from the 360° view, record sound, and move the crew to unseen places in ways that wouldn't hinder production.
3. Understand basic stitching limitations and choose where to shoot accordingly.
4. Get to know how the 360° camera rig would behave during production.
5. Explore the plug-in and get to know its frameworks. Try to have a clear idea of what can be done until the IBC Exhibition.
The following paragraphs will discuss these points in more detail.

In order to correctly achieve synchronization (point 1), two requirement emerged. First, it was mandatory to correctly use a clapper and try to have all directive cameras pointed at it at the moment of clapping for sync. This requirement also counts for the 360° rig which needed to have a clear view at it. Secondly, and this was a big issue during pre-production, we had to make sure that the files coming from *all* cameras had the very same frame rate. At the beginning this was an issue, but it was eventually fixed early on and it practically did not pose any problems during the actual post-production.

Regarding the shooting space or set (point 2), we had to learn how to choose and compose a scene with a set of limitations in mind, for example: is this a 360° appealing space? Will the consumer's point of view be worthwhile here? Hence, we learned about the major elements that make a 360° scene worth a consumer's time: *points of interest, information organization, complementary narrative events and proximity*. Some of these elements were used in pilot 1. However, before we could exercise this approach to the 360° image plane, we needed to solve the very basic problem of how to hide the directive cameras and crew. While searching for shooting locations good hiding spaces had to be taken into account. The locker room scene is a good example, since the used locker room in pilot 1 had in numerous lockers all around the area where the action would take place. After some testing, we concluded that the directive cameras could be fitted into the lockers, hiding them effectively from the 360° view and still making the synchronization process possible. A similar approach was implemented in all other scenes. An exception was made for the football game at F.C. Porto's Dragon Stadium considering that, due to an incredible amount of limitations for security and permit reasons, room for experimentation and possible locations for camera placing was considerably lower compared to other scenes.

In regard to sound, we used a method like the ones employed for directive cameras. There were hidden microphones to record ambience and environment, but mostly, we used lav microphones[1] tucked away in people's clothes. This was the best way to ensure audio coverage without compromising the immersive experience we were aiming to achieve.

When researching for a safe and effective way to correctly stitch a 360° image (point 3), testing was needed. This meant we had to explore different spaces with different typologies. That way, we came to realize that crowded spaces with lots of people would create problems on the stitching lines. After doing a test shoot on a subway, we noticed how hard it was and thus had to circumvent that problem by filming at a time of the day when the number of passengers was at the day's lowest. This still posed some issues during post-production, but thanks to extensive testing they were severely minimized.

All throughout this process, we were getting to know the 360° camera rig system, trying to understand its limitations, what works best and what isn't really a good idea to do (point 4). No issues occurred during the test phase, but it was only during actual production that one of our rigs malfunctioned (for reasons that are unclear), forcing us to halt production and schedule a reshoot for that very same scene.

While the testing on location took place, another part of the team was focused on running tests with the plug-in (point 5), using test footage previously shot. This allowed us to have a clear idea of what would be possible within the given timeframe and how different updates of the software impacted our workflow.

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[1] https://en.wikipedia.org/wiki/Lavalier_microphone

Production

A well-thought strategy and extensive testing of all the above mentioned elements in pre-production contributed to a relatively smooth and uneventful production process. The only problems encountered were the limitations imposed at the soccer game and the malfunction of one of our 360° rigs during shooting which caused significant delays.

Post-production

The entire post-production process was divided into four phases: editing 2D scenes, synchronizing them with the final omnidirectional image, creating the narrative structure for the pilot and designing the portals (a heavily technical task).

The first phase was to make sure we had all the 2D scenes assembled internally. In other words, the TV component of the project had to be finished as soon as possible, so we could focus on the important task at hand.

Once we established a correct synchronization between both images, the two latter phases that took the bigger part of the post-production process were essentially the narrative structure of the pilot and portal design. This is where we departed from the shooting script and reorganized certain events, eliminated or reduced others. It is commonplace in filmmaking that during the edition the transformation and interpretation of the material brought forth by the cameras take place. And so, since we felt the need for a common narrative thread that connected the entire pilot, the idea of dividing the interview scene between the kid and the coach seemed like a very organic and cinematic solution to create some mystery, but also to immediately tell the audience what the character cares about and the team of the story is - David's love for soccer and the place Dragon Force team has in his life. Structurally speaking, this was the biggest change in the shooting script.

As mentioned before, other changes that occurred during the editing process had to do with the elimination and/or reduction of a certain scene or even a narrative event. Some scenes, like the breakfast or subway scenes were substantially trimmed for a very simple, yet valid, reason: if after a certain point, a scene has nothing else to give us, if its narrative value drops, then it should be cut. However, ImmersiaTV being a joining of different types of images, another criterion developed which leads us back to the point of *what makes an omnidirectional image worthwhile?* If there is nothing there, as was the case with the previously mentioned scenes, then we must cut.

When it came to portal design, the 2D camera material used in the TV edit was the sole 2D material we had available. This meant we needed to be creative about what we would show the user, in both HMD and tablet. Since the portal-based interactivity wasn't working at the time we were preparing pilot 1 for the IBC debut, we only had access to two non-interactive features of the plug-in: *user reference* and *world reference* (i.e. a portal containing video travels, respectively, does not "travel" when the user looks around, see deliverable D2.3 for introduction of these concepts). It was then decided that the approach would be to provide an as different experience as possible between HMD and tablet. In order to do so, we switched the portal typology for each content and varied their respective position on the omnidirectional plane.

To conclude, the first pilot was executed without any major setbacks, only running into technical issues and problems (as previously mentioned) which can not be foreseen in advance, but such is the nature of this industry and of a project such as this one.

2.3. Lessons learned

1. *Simultaneous storytelling allows for new points of view in terms of narrative.*

What we're used to, by the so-called traditional media, is to have our point of view be guided by the director and/or the editor. The simultaneous storytelling that this project allows, changes all that. Now, the user can have access to other viewpoints on the action that were not present before. Let's say that a 2D TV version of the content shows us a mother yelling at her son for something he allegedly did. All we're shown is the mother yelling and the kid looking down, afraid and sad. However, if we decide to look around the room while using the HMD display, we might be able to see his younger brother hiding behind a piece of furniture, laughing. By doing so, we're changing the meaning we're given through the 2D perspective. Only by immersing ourselves in that world and actually wanting to find something else, besides what we've been previously showing, we will be able to see it.

This way of thinking was not yet used in pilot 1, since it was only discovered during post-production, after experimenting with complementary narrative structures while editing the main narrative body. Although it could have been interesting in the kitchen scene. Mom, for example, could have asked the kids if they've seen the cat. As they answer no, the user could have seen the cat hiding under the table.

2. *Producing content that mixes 2D images with 360° requires a different approach to production but most of all to post-production since editing becomes a whole different task.*

Linearity versus non-linearity is a pretty tackled subject in the world of editing, whether it's film editing or in this specific case video editing. However, when mixing two very different ways of perceiving reality itself - from 2D to 3D - this discussion must fundamentally change. What we should be reflecting on, instead of linear versus non-linear, is simultaneous versus concurrent, or in other words synchronous versus asynchronous. This being said, if it's only a matter of having synchronized images and sounds that's not really the point. When we enter upon such a debate we must come to face with another, deeper, question: objectivity versus subjectivity (supposing we can clearly tell the two of them apart). For the sake of the current line of thought, let's consider that 2D represents objectivity while 360° (or 3D) represents subjectivity. Linearity or non-linearity can still be a part of this discussion but what makes it truly interesting is the fact that this deeply transforms editing, the art of assembling images, by opening up the possibility of a multiverse of actions. This multiverse of actions opens up new possibilities for plot, sub-plot, narrative, backstory, overshadowing other narrative construction related subjects.

As a result, editing is no longer the joining of two images to create meaning, but more about creating a carefully constructed narrative web that is solid enough to sustain itself on a objective (2D) language, linear or non-linear, and at the same time interesting enough to become subjective (3D) by inviting the user to immerse himself into that world and/or story. It is clear that we're not dealing with a simple concept anymore. A triangle arises: we're talking about **linear or non-linear synchronicity that must be both objective and subjective at all times**. This could lead to interesting research on the evolution of storytelling.

3. PILOT TOOLING

This section describes the production tooling used to create pilot 1 content and the infrastructure deployed to deliver and display it. This is based on the work carried out in WP3 which represents the software implementation by the ImmersiaTV partners. All necessary stages for running the pilot are listed in figure 2. The implemented tools have been mainly used in two stages of the project:

1. **Content edition**: the creation of content (i.e. shooting of the documentary) started before the pilot and the edition took place during part of the first pilot, starting in M08 until M09. Right before IBC (M09) a first full-length version of the documentary was ready. To achieve this goal, production teams edited content with Adobe Premiere Pro and the post-production tools developed by i2CAT and PSNC. These tools were also useful during the pilot execution phase, e.g. to run tests, and to improve the initial version of the documentary.

2. **Content display**: With "content display" we understand all the processes and technologies necessary to watch the content. From our perspective this process includes content encoding and distribution, using the MPEG-DASH standard and DOCKER containers, followed by the content consumption in multiple and synchronised devices.

In the following sections, there is a detailed description of what and how elements have been used during pilot 1.

Figure 2: The production workflow

3.1.   Content edition toolkit

Description

For pilot 1, ImmersiaTV offers a plug-in on Adobe Premiere Pro with two sub-components for the production of omnidirectional content. The first one is an offline production service to simplify omnidirectional video editing and post-production. This service enables synchronization and combination of both immersive and traditional video clips into a single production pipeline in Adobe Premiere Pro, for instance when creating transition portals used to add directed videos in an omnidirectional scene. The second service controls the content export process. When exporting a project, users (content producers) will be able to select what content is exported (360, portals, directive) and on which devices it will be available.

The current main features are summarised below:

- Combine immersive experiences with traditional content and introduce elements of interaction;
- Simultaneous off-line production for different devices;
- Simple user interface tailored to a video-editor workflow;
- All this features have been packed and integrated in a plug-in for Adobe Premiere Pro, a reference software for all video and content editors. The plug-in is shown in figure 3.
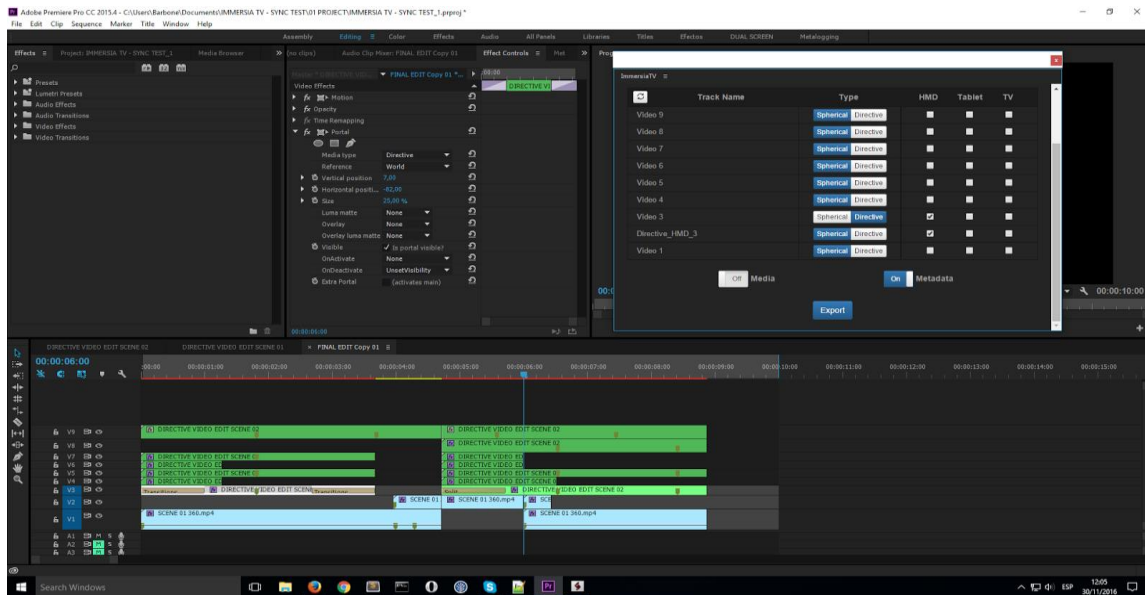
Figure 3: The plug-in for Adobe Premiere Pro. In the left-hand of the screen, there is the control menu for portals. On the right-hand side the export feature, in which users can customise what content and devices are used to visualise the content, can be seen.

With this approach it is possible to define different content timelines for different devices, to synchronize and to set relations between them, thereby mixing immersive and non-immersive footage into an appealing end user experience. The editor can introduce elements of interactivity with the portal effect, allowing viewers to influence the content shown.

The final project is straightforwardly exported to be directly delivered to the multi-platform audience devices.

Application in the pilot

Once the directive and non-directive contents were shot, it was necessary to create a coherent story mixing both type of content, and also the portals and transitions. Using Adobe Premiere Pro (Pr), the linear documentary was created following the regular TV production chain. This process was then followed by the inclusion and synchronisation of the 360° videos and the creation of scenes (a pack of synchronized 360 streams) using the plug-in developed for this purpose. Transitions between scenes were added later, trying to synchronise these transitions with the original ones created in the main directive content. The final step was the addition of *Interactive Portals.* Again, using the plug-in for Pr, some portals were added as a test, just to display additional content which was not part of the core of the story (alternative views, etc.). It is important to highlight that portals usage is evaluated from different perspectives, including what kind of content adds more value and how and when this is displayed.

The second part of the edition focuses on the export process. Once the project is finished it is necessary to export the files by selecting the targeted device and the type of content being

exported (i.e. omnidirectional or traditional video), and associated metadata to compose them (for instance, location of traditional video inserts in an omnidirectional video). This can now be done easily with the Adobe Premiere Pro plug-in. The result can then be stored online in a server from where it will be consumed.

More specifically, this solution has been used in pilot 1 during the production of the documentary and its later improved releases. Finally, as part of a training session at Catholic University of Porto (UCP), the plug-in was showcased and its main features were introduced in a hand-on session.

3.2.   Content distribution and display toolkit

Next to the edition tools, also a publication and distribution pipeline has been implemented, as well as a multi-platform player to play the different contents. We further explain the main components and the most important parameters selected for Pilot 1.

The publication of content has been done through a web application developed with modern web technologies such as Node JS[2] and AngularJS[3]. This web application lists content exported from the Premiere post-production tool that is ready to be transcoded to MPEG-DASH[4] (see the drop down menu option "Convert" in figure 4).
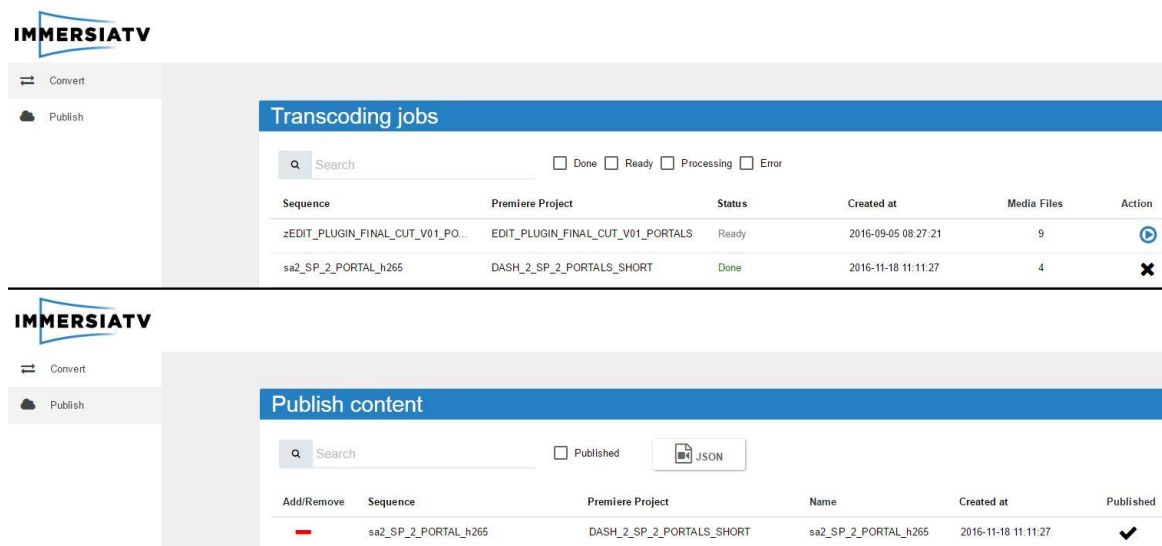
Figure 4: The distribution and publication web application view. Convert to MPEG-DASH section on top, publication content below.

Once the MPEG-DASH conversion has ended, new content will appear in the section "Publish" of the web page, where the user, for example a broadcaster, can publish content for its later consumption by the end users.

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[2] Open-source, cross-platform JavaScript runtime environment for developing a diverse variety of tools and applications. https://nodejs.org/en/

[3] JavaScript-based open-source front-end web application framework. https://angularjs.org

[4] Adaptive bitrate streaming technique. https://en.wikipedia.org/wiki/Dynamic_Adaptive_Streaming_over_HTTP

The publishing action consists in making the url of the XML metadata, which in turn contains the MPEG-DASH MPD (Media Presentation Descriptor) paths, publicly available and ready to be consumed by the player that already knows what the URL of the published XML file is.

To provide a more robust infrastructure, along with the web application an Nginx web server was deployed to distribute the content. This secures media distribution regardless of the web application's state and therefore makes it more robust, for example to DDoS attacks. All the different modules have been deployed inside a Linux server using the Docker platform.
The media encoding process is implemented as a cloud service, running on a Linux server using the Dockers virtualization tool.
To encode the video we first resize the video source according to the desired output resolution. For this, the main configuration parameters are: a regular GOP (Group of Pictures) referred to the length of the MPEG-DASH segments, and a constant bitrate. The video and audio streams are encoded in H.264 and AAC based on MPEG-DASH (ISO/IEC 23009-1:2014). This process is performed using the multimedia framework Ffmpeg[5].

The next step is to generate the MPD and the MPEG-DASH fragments from the preprocessed video. The main configuration parameter is the length of the fragments. This process is performed using the GPAC[6] framework , specifically the MP4Box tool[7]. The generated media is divided in 3 different sets: 360, TV and portal videos (i.e., video inserts). The chosen resolutions are HD (1080p) and UHD (2k, 4k) for the 360 and TV video, and 420p for the portal video. The final media set is (4k,4k,420p), (2k,2k,420p), (1080p,1080p,420p) with fragments that have a length of 3 seconds.

Furthermore, we designed the user experience of the end-user for each of the three consumption devices. The general workflow is as follows. The player starts showing a content list downloaded from the content publication server. Once the content is selected, the player parses the xml file assigned to that content. The parsing of the xml file triggers the creation and destruction of geometric shapes that will appear in the scene, over which the different videos will be rendered. These shapes are currently spheres for omnidirectional videos and rectangles for directive videos. The position of the shapes and their visualization in the scene will depend of the device, as defined explicitly in the xml file. Basic interaction is managed on the shapes, for example to enable or disable other shapes or trigger transitions between them. Further work in this direction will continue towards preparing pilot 3.
Finally, all the devices are synchronized with each other, as well as the playout of all the videos in each device. For this purpose, a specific module to manage the session has been implemented, based on the DVBCSS standard[8].

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[5] Software project that produces libraries and programs for handling multimedia data.
  https://ffmpeg.org
[6] https://gpac.wp.mines-telecom.fr/home/
[7] https://gpac.wp.mines-telecom.fr/mp4box/
[8] https://www.dvb.org/standards/dvb_css/

4. PILOT EVALUATION

The pilot evaluation activities for pilot 1 were outlined in deliverable 4.1. In this deliverable we give an overview of the specific evaluation activities related to 1) the software tools and 2) the developed documentary. These activities took place between May 2016 and December 2016. The specific results of the different mentioned evaluation activities can be consulted in deliverable 4.4.

4.1.   Content creation toolkit

Iterative development of the plug-in

A first evaluation activity, starting in May 2016, was the feedback on the developed content creation toolkit and more specific on the developed plug-in. To ensure a user-centered design process, multiple iterations were planned in which content producers at both Lightbox and VRT tested the software. Feedback was provided via an online survey as well as during dedicated feedback meetings via conference call. The remarks of the professional users were integrated as much as possible in the new developed versions of the software plug-in. A new version of the software was released and tested on a weekly basis. Additional evaluation activities for the content creation toolkit will take place at Lightbox and VRT in the first quarter of 2017.

Immersive content production workshop

On Monday November 21, a half-day workshop on immersive video content production was organised at the UCP (Universidade Catolica Portuguesa) - see figure 5. This workshop was organised as part of the Science and Technology Week 2016 in Porto. The workshop consisted of a lecture explaining the different tools and a hands-on session in which participants could test the software. 12 people participated in the workshop, consisting of a mix of university staff, PhD researchers and master students. All participants completed an evaluation form after the workshop.

Figure 5: Workshop at UCP

The workshop was divided into two parts. In the first part VideoStitch explained how videos can be acquired and stitched. Here different cameras and rigs were presented and the post-production stitching workflow was explained. In the second part, Lightbox discussed how to edit and add metadata. The use of the Adobe Premiere Pro plug-in was demonstrated and the required actions to set-up a project and add timelines was described. Participants could then test and experiment with the different tools. The full programme of the workshop is given in 'Annex II – Detailed workshop outline'.

4.2. Demo booth at IBC and NEM

ImmersiaTV was represented with a demo booth at both IBC [9] in Amsterdam, the Netherlands (September 9-13, 2016) and NEM [10] in Porto, Portugal (November 23-25, 2016). In both events the first pilot was demonstrated, including the developed toolkit and the immersive documentary. Participants could try out the documentary on the HMD and tablet in combination with the television set and could also try out the developed software plug-in. At IBC informal evaluations took place including discussions with participants and the recording of some video testimonials. At NEM, participants who visited the demo booth were asked to answer some questions on their experience (Computer Assisted Personal Interview CAPI via tablet). In total 20 people shared their experience with the pilot demo at NEM. The ImmersiaTV demo, shown in figure 6, has won the NEM award for best demo booth.

Figure 6: The demo booth at NEM

4.3. Closed pilot at UCP

On November 21st and 22nd, a closed pilot test took place at the UCP - see figure 7. 28 participants tested the developed immersive documentary. Respondents could participate

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[9] International Broadcasting Convention. http://www.ibc.org

[10] New European Media Summit. https://nem-initiative.org

individually or in teams of 2. The pilot activity consisted of a viewing of the documentary in which participants could decide for themselves how they wanted to make use of the different available devices (TV, tablet or Head-Mounted Display). Each session was observed to see 1) how participants made use of the different devices during viewing; 2) how they used the different devices (e.g. sitting, standing, ...) and 3) which social interactions they had during viewing (e.g. talk about the content etc.). After the viewing, an interview took place to discuss their viewing experience.

Additional pilot activities that will take place in the first quarter of 2017 include: closed pilot test in Brussels and a semi-open pilot test (see D4.1. for a full description).

Figure 7: Pilot 1 evaluation at UCP

5. ANNEX I – PILOT SCENARIO

SCENE 1

KID'S ROOM

It's early in the morning, the room is still dark and the kid is sleeping in his bed. Viewers can hear footsteps coming from one side (the side of the door). Someone opens the door.

[**TV**: user will hear the steps and a transition will enable them to see the mother walking into the room and waking up her son. It is possible to include an icon alerting TV viewer that he can get extra info on other device.]

[**HMD**: The footsteps will indicate that the user can look the way where the sound (steps) comes from by moving his head. He will see the mother opening the door and entering the room. Spatialized sound.]

[**Tablet**: user can see extra info about the location. For example: Portugal, Porto, 07:30, Silva house.]

The mother enters the room, stays a little while watching her son sleeping and starts to wake him up.

<div align="center">

MOTHER:

David, it's time for you to wake up.

</div>

The kid initially turns his face around but then he raises his head and looks for his football gear the other side of the room.

[**TV**: 4 shots: sleeping; door opening; mother talking; kid looking at the football gear; kid getting up.]

[**HMD:** Can watch what the kid is watching.]

[**Tablet**: Can watch what he is watching.]

The kid gets up and goes to the kitchen for breakfast.

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SCENE 2

FAMILY IN THE KITCHEN

Conversation between the members of the family around the kitchen table while having breakfast. Mom (Teresa), dad (Miguel), the kid (David) and his sister (Maria).

Users can hear other noises such as a cat (Emilio) meowing.

The conversation is a normal one, from a family point of view. Father asks David how is it going in the football club. The sister says she wants to join too. The family smiles and say she can, when she's a little bit older.

Mother alerts kid for the fact that school is very important. That his grades should be good, not only good at football but also at school.

The camera goes from one person to another, as they are talking.

[**TV**: subjective camera, like if the user was sitting with the family. Only sees cat when it enters framing by climbing to the table. There are some details, complementary to the story but not relevant for main narrative, that will happen only on other devices. This way we prevent the TV of feeling like he is missing out something important.]

[**HMD**: subjective camera, like if the user was sitting with the family. The HMD user can look for the cat when he hears it; when the user focus his attention on the cat, a portal comes up. He can see graphic info about the cat: name, for how long it is with the family, etc.]

[**Tablet**: icon indication of more info of each character. Each person at the kitchen has a graphic ID: name, age, job, etc. User can look for the cat and see graphic ID about it too. When he stops at Emilio the device vibrates, a call to action, so the user can click for another video of Emilio: ex: Click on Emilio and find out what it has done to the ham that was at the kitchen table. If the user goes for the cat video he must be aware that he will lose the image of main narrative. Assuming that the user on the tablet will have the TV on, he will be able to see the main narrative on TV and simultaneously, check the cat video. When he dismisses the cat video he will be sent to the point where the main narrative is now, fully aware that he missed some parts.]

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SCENE 3 AND 4

STREET AND SUBWAY

The kid is walking with with a sports bag to the metro station. It is a short walk.

[**TV**: user sees the kid perspective (subjective camera). Icon allerting for more info on other devices.]

[**HMD**: subjective camera. User can see the street, other people passing by, neighbors saying hello as it was for him.]

[**Tablet**: can see the street (arrows that indicate the abbility to move around, other people passing by, see graphic info of the neighbourhood, ex: the location of the kid and the location of the field, how far he is.]

The kid enters the subway and sits down with a ball in his hands. The ball falls.

[**TV**: user first hears someone talking and then sees the person who catches the ball and returns it to the kid.]

[**HMD**: user can see the subway and where does the ball go. Another kid (a team colleague: Fábio) catches the ball and starts talking to the user has if he was David.]

[**Tablet**: can see the subway and where does the ball go. Another kid (a team colleague: Fábio) catches the ball and starts talking to the user has if he was David.]

Fábio returns the ball to David and sits next to him.

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SCENE 5

DRAGON FORCE LOCKER ROOM

At this scene all users will feel what it's like to be at a locker room. There will be no dialogues, just the kids getting ready for the practice. They talk, laugh, joke around. The purpose is for the users to feel the atmosphere, like a sneak peek.

Users hear a whistle and watch the kids running to the field, leaving the locker room empty.

Kids getting into the locker room. All the kids playing around and heading to the field when they hear a whistle.

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SCENE 6

THE FIELD – INTERVIEW

At the field, the kid starts talking about himself.

DAVID

I'm David, I'm 14 years old and this is my left foot (laughs).

All users can hear the other kids laughing out loud and saying: Next Messi; He's the best!, …

[**TV**: user can hear the other kids but only when the plan changes they are able to see them.]

[**HMD**: when he hears the other kids, user understand that he can move his head to see the others kids, the field and the surrounding areas.]

[**Tablet**: user can see the others kids, the field, the surrounding areas. Dragon Force logo appears. If he taps on the logo, it will show extra info about the football school.]

The interview is conducted between coach and player. They are changing the ball while they are talking. They run, laugh, make and answer questions.

When the coach asks who is his favourite player, David answers Messi. As he talks about him, images of the international football player start to appear in the screens in different ways.

[**TV**: user can see the change of focus between each one. Icon appears when Messi's footage appears on other devices, alerting for him to connect to the tablet to watch it.]

[**HMD**: user can see both of them or just one of them, by turning his head. A portal appears with footage from Messi.]

[**Tablet**: user can see both of them or just one of them. When the kid starts talking about Messi, the user can see an icon alerting for other video of Messi, with all the player outstanding statistics (goals, awards, etc.); icon to go back at any time to the main narrative.]

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SCENE 7

THE GAME

Shots of the game between David's team and another one. When he strikes the ball, the shot changes to the goalkeeper. He jumps to stop the ball but it just passes right through. GOAL!

[**TV**: user can see the change of focus between each one; follows the director's choice.]

[**HMD**: user can chose the camera's point of view. From the field, from the team bench of from the audience. When David strikes a goal, a portal opens with footage of simmiliar strikes in the history of football.]

[Tablet: user can chose the camera's point of view (from the team bench, from the audience or in the field).]

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SCENE 8

FAMILY TRIP

The family is in the car, driving home. During the trip, they talk about the game, how exciting it was to see David leading his team to victory.

[**TV**: user can see each person when they are talking. follows the director's choice.]

[**HMD**: user is "seated" in the backseat, like if he was on the car too. From this point of view, he can rotate the head and see the kid and his sister, one in each side. In front, he can see the mother and father. Can look away through the window.]

[**Tablet**: user can look away through the window, can focus on one person.]

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SCENE 9

THE SCHOOL

Another day. David is at school. Classroom shot. Omni camera shoots the class and the recess (playing football, of course).

[**TV**: user can see a master shot of the classroom with transitions to close-ups of the students and teacher.]

[**HMD**: user can see the students side of the classroom (180º) and the teatcher side (180º). Teacher is talking about a mathematical concept. When the user focus on the teacher the board becomes a portal with graphic footage of the mathematical concept explained like football. Pythagorean theorem explained like 3 kids were changing the ball between them.]

[**Tablet**: user can see the students side of the classroom (180º) and the teatcher side (180º). Teacher is talking about a mathematical concept, the Pythagorean theorem. An icon appears that can lead the user to a website (wikipedia) for the definition of the concept, allerting that he will lose the image of main narrative but keeping the sound of it. He will be able to still hear the teacher but will be led to na outsider webpage. User can go back to the classroom whenever he wants, fully aware of what he missed.]

The bell rings and all the kids run to the yard. The teacher tells David to wait a little longer and starts talking with him.

[**TV**: user can see the students leaving the classroom. And then a transition to the teacher/student conversation.]

[**HMD**: user can see the students leaving the classroom and can see them outside playing but now at a certain distance. If he looks the other way, to the classroom, he can see the teacher/student conversation. The user hears in surround both the kids outside and the conversation inside. Depending on where he is focused, he hears the sound louder. This will indicate the user that he can see both scenes by moving his head in one direction or the other.]

[**Tablet:** user can see the students leaving the classroom and can see them outside playing but now at a certain distance. He can go outsider but he must be fully aware that he will lose the conversation.]

The teacher tells David that although he is a great promise in football, he must not forget to complete his studies. A football career is short and he must have the knowledge to continue studying so he has a brilliant future even after his career in sports.

David thanks his teacher's advice and says he knows that. Other football players are also university graduates and he wants to do the same.

[**TV**: user can watch the conversation.]

[**HMD**: user follows the conversation. When David talks about other football players who graduated, a portal appears with footage of famous footballers who finished college.]

[**Tablet:** can choose between watching the conversation of watching the kids playing outside.]

David leaves the classroom to meet with his colleagues. He cames back and says to the teacher:

DAVID

Miss, I would like you to come one day to watch a game.

Even if you don't like football.

He then runs to the field.

END CREDITS

End credits appear graphically with extra footage of the making of.

[**TV**: user watches end credits and windows with footage of the making-of.]

[**HMD**: Watches the kids playing outside with end credits above and a portal showing the making-of.]

[**Tablet:** Watches the kids playing outside with end credits above. Links for the companies who created the documentary and video of the making-of.]

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6. ANNEX II – DETAILED WORKSHOP OUTLINE

9.30h - Welcome
9.35h - **1st Part: Acquiring videos and stitching them (VideoStitch)**

1. INTRODUCTION
We will provide some information on VideoStitch and the trainer, and let the attendees introduce themselves, including what they know about 360° videos.

2. 360 VIDEOS: CAMERAS, RIGS AND ISSUES
We will show here some examples of existing cameras and rigs, and discuss the main differences between them.
We will also explain video stitching and show the big picture, and make sure the students understand what parallax issues are.

3. TYPICAL POST-PRODUCTION STITCHING WORKFLOW
This section will present the typical workflow of post-production stitching with VideoStitch Studio.
In particular, the students will be walked through the following steps:
○ synchronization: making sure all the inputs are temporally aligned
○ calibration: automatically discovering the relationships between the cameras on the rig
○ color correction: the cameras are usually independent systems, with their own exposure and white-balance settings. How do we make up for them?
○ stabilization: if the camera rig is moving, sudden position changes will result in motion sickness for the viewers in an immersive helmet. Fortunately, this kind of motion can be smoothed out
○ orientation: the calibration has no knowledge about the horizon, how can we reorient the video to preserve it?
○ blending configuration: there are several blending options to limit the artefacts due to the cameras parallax
○ rendering: this final step actually exports the 360° video

4. HANDS-ON SESSION
The students will have an opportunity to stitch themselves a 360° video, under the guidance of the trainer, either on their own laptops, or on the trainer's machine.

5. OTHER USE CASES
We will briefly discuss live/real-time stitching with Vahana VR and introduce the Orah 4i camera, and the workflow differences with post-production stitching.

6. FURTHER READINGS
As a conclusion, we will present our YouTube tutorials at https://www.youtube.com/user/TheVideoStitch and provide our user guide to the students.

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11.00h - **2nd Part: Editing and Metadata (LightBox)**

1. INTRODUCTION TO THE PLUG-IN IN PREMIERE PRO
Provide some background on the editing side of the project and introduce the
framework and workflow used to assemble the pilot showcased at IBC. Define
the typology of the plug-in and where to find it in the app.

2. SETTING UP THE PROJECT & TIMELINES
Explain the resolution we're working in, and why. Having a correct project setup
and correctly configured timelines is an important step in order to understand
the proper way to use the tool at hand.

3. EXERCISE #1 - CREATING PORTALS
Introduction to the types of portals and types of media related to each one. The
audience will be given two separate scenes. In the first one, we'll be working on
how to correctly place a single "normal" portal. On the second one, we'll
introduced other types of portals, but most importantly, they'll be left to try it
out by themselves.

4. EXERCISE #2 - SCENE TRANSITIONS
After a correct comprehension of the portals and their framework is established,
it's time to introduce scene transitions on a 360o plane. This will be applied
between the two previously edited scenes in order to come full circle and give a
good sense of how the first pilot was put together.

5. THOUGHTS AND REFLECTIONS ON THE PARADIGM SHIFT BROUGHT BY
IMMERSIA TV
Based on the additional notes provided for the IBC presentation created by
Lightbox, and seeing as this workshop is directed towards the Research Centre
for Science and Technology of the Arts, we think it's befitting to end this by
sharing our thoughts on this matter. Focusing on the two main take-aways:
simultaneous storytelling allows for new points of view in terms of narrative,
and, producing content that mixes 2D images with 360o requires a different
approach to production but most of all, to post production - editing becomes a
whole different process.