SEVENTH FRAMEWORK PROGRAMME

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Farewell from the Project Coordinator

It is now time to look back on three and a half years of busy research and development, on fruitful and close collaboration between eleven partners and a series of impressive demonstrations and presentations. Now we can say that we have reached the aims of the project – something that is not guaranteed when you start with the vision of implementing a potential TV-format of the future.

The highlight, at the end of the project, was the final demonstration held at the University of Salford in MediaCityUK on May 30th 2013 where we showed a live system covering all aspects from capture, to production, delivery, rendering and end user interaction. The performance featured "deeper than all roses" a composition from Stephen Davismoon (premièred on 4th May 2013 at Ohio Northern University) and a dance piece choreographed by Joseph Lau and performed by Joseph Lau and Shona Roberts. The music was performed by Bears?Bears! a talented group of musicians set to graduate from the University of Salford in 2013. We used the Digital Performance lab and surrounding facilities at MediaCityUK for the performance and to demonstrate the different components of the system developed in the project. More than sixty people experienced the three live demonstrations and used the offline demos to get further insights and to discuss with the researchers from the project.

I would like to thank all the people involved in the project for the exceptional collaboration throughout the project and look forward to further collaborations. It was a highly motivating experience for me!

For more information please visit www.fascinate-project.eu or follow us on twitter "@Fascinate_Prjct".

Georg Thallinger,

Project Coordinator

FascinatE @ EuroITV 2013

Special points of interest:

- Final Demonstration of the 3.5 year FascinatE project
- Future Broadcast Training Day for students
- Mobile applications
- The ARRI ALEXA M, a modular ALEXA

FascinatE gave its last public performance at EuroITV 2013, the 11th edition of the European Interactive TV Conference series. EuroITV is the leading international conference for media and interaction related to video and television and was held in Como, Italy, from June 24 - 26, 2013.

At EuroITV, FascinatE partners organized the 1st International Workshop on Interactive Content Consumption (WSICC), with a focus on novel forms of interactive content consumption. The workshop's objective was to provide a highly interactive discussion forum and to capture a comprehensive view on this research area. With over 20 participants, the workshop had a great start thanks to an inspiring and challenging keynote by Associate Professor Wei Tsang Ooi, Department of Computer Science, National University of Singapore. His talk, entitled "The Best Interactive System is a Non-Interactive System", triggered animated discussions among the participants, that continued during the subsequent poster and demonstration session. Interactivity came really into play with the fishbowl discussion, where people eagerly tried to obtain one of the discussion seats to actively participate. Apart from the workshop organisation, several FascinatE partners were present with technology demonstrations and presentations, notably tiled streaming, content analysis and virtual director technology.

Additionally FascinatE partners presented several papers and technology demonstrations during the main conference. The Interactive Institute presented new results on interaction with panoramic video content. JOANNEUM RESEARCH presented a paper on the Virtual Director. A joint TNO/Alcatel-Lucent paper on hybrid delivery networks received a Best Paper Honorable Mention and two FascinatE technology demonstrations ended up at second and third place in the Best Demo Award competition. Next year, EuroITV continues as a fully ACM sponsored conference, named TVX, the ACM International Conference on Interactive Experiences for TV and Online Video.

Figure 1. FascinatE Training Day details shown on screens throughout the building

The FascinatE project held a training day at the University of Salford's building at the UK's newest centre for the creative and digital sectors, MediaCityUK in March 2013. The day was aimed at raising the awareness of students in science, technology, broadcast and media programmes about the future of broadcast technology and what kind of broadcast environment they may find themselves working in after graduation.

The day consisted of a series of masterclasses explaining some of the developments made during the FascinatE project and demonstrations of some of the technology developed.

Preparation for the day had all FascinatE partners working hard at preparing demonstrations of elements of the project that were to be shown. In one instance, four separate parts of the project from four partners, were integrated ready for a demonstration of live streaming of higher order ambisonics from an Eigenmike to a 16 loudspeaker ambisonic rig. This demonstration was shown for the first time during this event. The FascinatE Virtual Director was also shown working and outputs were utilised for some user assessments of the rendered output. Streaming of immersive media over the internet was demonstrated and a short documentary of our test shoot at the Arena in Berlin shown on the large screen in the entrance foyer of the building. Demonstrations were enjoyed very much by attendees on the day and presentations in the morning and afternoon explained many of the principles of the technologies that have been developed during the project.

All presentations were recorded and these will soon be made available as online seminars about many aspects of the project providing a long-lasting set of training materials for use by students and interested industry professionals. The experience of the Training Day also worked well as a good preparation for our final demonstration, which was also held at MediaCityUK using some of the same facilities and showed the entire FascinatE systems integrated for the first time.

Figure 2. Martin from TNO explains the use of a second screen to view or control the streamed output of the FascinatE system

Figure 3. Rene from JOANNEUM RESEARCH explains the FascinatE virtual director system

Assessing User Interaction with a Gesture Based Interactive Television System

The Fascinate panoramic video can be manipulated with a range of different types of interaction techniques. Universitat Politècnica de Catalonia has developed a system for the home in particular, based on arm and hand gestures in front of the large screen or television. At the Interactive Institute we evaluated how users might interact with such a system and what the benefits of social interaction around such a system could be. In November 2012 we set up a living-room like area in our research lab and invited 20 people to use the

Figure 4. Participants interacting with FascinatE in a 'living room' lab

system to view and interact with different types of content: A football match and a dance performance. Fourteen of the participants interacted as pairs, six of them interacted alone. We observed all the users and asked them to conduct certain tasks; all tests were video taped and we interviewed users afterwards about their experiences.

"users explained the use of the panorama as a mechanism for orientation and something you could 'go back to' if you lose yourself in the navigation"

Generally, the participants were able to use the gesture-based system to access particular regions of the video and to turn the volume up and down. In terms of using the larger screen where the full panoramic content was running during the tablet test, participants found it useful to get an overview. They did express hesitancy though, in terms of too many interaction options: having too many options can affect the experience of the content in a negative way, some of them worried. They might miss out on an important event like a goal, if they were busy interacting with the system.

In terms of panoramic view, users explained the use of the panorama as a mechanism for orientation and something you could "go back to" if you loose yourself in the navigation. In that sense the panorama could be understood as an interactive map that gives you a greater understanding of the scene. One user's explanation of the panorama as a

Figure 5. Navigating the FascinatE panorama with gesture powered interaction

menu emphasised that there is a certain value of organisation within the bigger context. Having the panoramic view readily available as an overview was highly appreciated, and an important feature for relaxed exploration in panoramic ultra-high definition television formats.

We found that the relation between what people said they prefer in terms of social viewing and how they interacted together was in some cases contradictory; where they explicitly asked for social functionality such as embedded communication, they were also demonstrating a need to simply just watch the content without having to be social around it.

A major conclusion that emerged from our studies is that people like being part of a larger context, which usually involves communication around a live event and navigating the content together in a social setting. The gesture interaction system was able to provide this larger context to a certain extent. However, our participants also expressed an interest in having their own view of the event, which could be facilitated in some way by the gesture user interface but, which should also be accessible through more simple actions.

Figure 6. Participants taking control of the panorama navigation via a gesture-based interface

Figure 7. Ultra High definition panoramic video of a live performance broadcast in real-time during the final demonstration at MediaCityUK, Salford and, inset, the OMNICAM capturing the panorama..

The 30th May 2013 marked the final demonstration of the full FascinatE system. The project has developed a complete end-to-end future broadcast system which combines ultra-high definition panoramic video, 3D ambisonic and object-based audio, new methods for delivery of interactive AV content and new interfaces and methods to interact with the AV media at the user end. All of these aspects were on show for a live demonstration of the complete integrated system.

The demonstration event was hosted by The University of Salford at their MediaCityUK which is one of the few places that had the complete set of facilities to support what we were trying to do. The infrastructure of the building was actually designed for this sort of thing and was tested to the limit by the FascinatE team for this event. FascinatE partners worked through the nights and the tech support team at MediaCityUK pulled out all the stops to make it happen smoothly.

The event featured a live performance in the Digital Performance Lab (DPL) which was recorded and streamed live to a conference suite (The Egg) on the other side of the building. The live demonstration was based around the premiere performance of 'Deeper than all roses', the latest large-scale music composition from Stephen Davismoon featuring rock band Bears?Bears! and live performance artists Joseph Lau and Shona Roberts in celebration of the works of the American poet E.E. Cummings.

Visitors were invited to view the performance being relayed live to the Egg presentation room and also the live performance in the DPL. The Egg was equipped with a large data projector and an ambisonic spatial audio rendering system consisting of 17 loudspeakers. The live demonstration was divided into three phases, allowing specific aspects of the technology to be highlighted (full bandwidth interactive experience, content streaming on a lower bandwidth network and the virtual director). Visitors were also invited to look around the many offline demos which were on display in the foyer of the MediaCityUK building.

Figure 8. Live streamed output to the Egg Suite audience

Figure 9. The OMNICAM capturing the live performance

The performance was captured with the OMNICAM panoramic camera, using the latest version comprising of 10 HD cameras capable of giving a 10k x 2k 360-degree panoramic image, of which 5 cameras were used for the demo to produce a 180-degree live video panorama. A manned HD broadcast camera placed close to the OMNICAM captured close-ups of particular areas of interest. The video from this was ingested into an IP-based production framework, running a plug-in that generated camera metadata describing pan, tilt and zoom derived by tracking background features in the image.

"AV data was streamed in real time to a range of displays and audio systems"

Audio was captured using an Eigenmike to generate a 4th order Ambisonic representation of the ambient sound in the performance room. Six additional audio objects were also captured using mics on the guitar amplifiers, drum kit and the PA speakers used by the singers. The DPL also housed a WiFi access point, providing network access to a set of tablet computers that visitors could use to explore the live panoramic image in real time.

All of this AV data was streamed in real time to a range of displays from TV sets, large projectors, a Christie tile wall in the building foyer and to iOS and Android mobile devices. The FascinatE virtual director framed shots and made production decisions base on video analysis. People at the demo could freely pan and zoom around the panorama, controlling their own virtual camera by swipes on tablets or by intuitive hand gestures using Kinect for larger displays. The demonstration was hailed as a great success by all who attended.
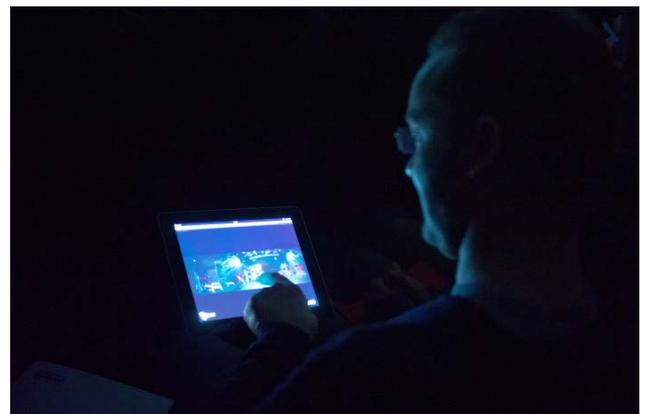

Figure 10. The Eigenmike captures audio in higher order ambisonic format which is then combined with audio objects for rendering

Figure 11. Live interaction with the panorama on tablets during the performance in the DPL at MediaCityUK.

OMNICAM and the Development of the ARRI ALEXA M

The ALEXA M is one model in a range of ALEXA digital cameras from ARRI, the Munich-based company that has been developing state-of-the-art motion picture technology for nearly a century. Since its launch in 2010, the ALEXA system has been used on countless film and television productions, including the two top-grossing movies of 2012 (The Avengers and Skyfall) and the last two films to win the Oscar for cinematography (Life of Pi and Hugo).

Physically different from all other ALEXA models but sharing their underlying technology as well as their exceptional image quality, the ALEXA M separates the camera head from its body in order to minimize size and weight. The development was initiated by the requirements of the OMNICAM capturing system. Six ALEXA M heads equipped with 24 mm Ultra Prime lenses are rigged beneath

"Filmmakers appreciate the freedom afforded by the ALEXA M"

mirrors on the panoramic camera, creating a 180-degree viewing angle. The heads are connected by optical fiber cable to a video control room that can be more than 100 meters away if needed be.

In May 2012 the OMNICAM was at Berlin's Arena Hall to record a performance of MusicDANCE - Carmen, an education project based on Rodion Shchedrin's Carmen Suite. This was the first opportunity to test ALEXA M cameras with the OMNICAM, and the quality of the images far exceeded what had previously been possible. A further test production was carried out at London's Royal Albert Hall in August, when the OMNICAM captured a classical concert during The BBC Proms, permitting further optimization of the camera setup and providing high-contrast
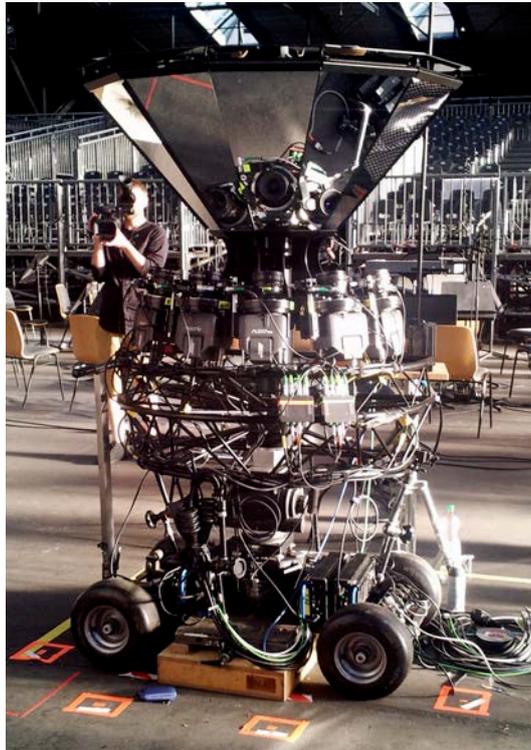

Figure 12. The OMNICAM with ALEXA M cameras at the Berlin Arena for s FascinatE test shoot

content for progressing research into interactive viewing experiences of panoramas.

FascinatE project coordinator Georg Thallinger notes, "The ALEXA M is the perfect camera in terms of quality and size to fit in the OMNICAM. We want to engage audiences with a new viewing experience. We knew, being ARRI cameras, they would shoot beautiful images and have the best quality."

Although the design of the ALEXA M was initially driven by the requirements of the OMNICAM and was conducted within the FascinatE project, ARRI has since invested into the product development for many demanding applications and has had considerable success with the camera in its traditional market of film and television productions. Filmmakers appreciate the freedom afforded by the M in situations where space is limited, or when filming handheld. Academy Award-winning director James Cameron invested in ALEXA M cameras for the 3D rigs offered by his company, and top cinematographer Chris Menges, BSC, ASC, chose to work with the ALEXA M on the soon-to-be-released movie Hummingbird. The ALEXA M has also made its mark on television dramas, and was used extensively on the highly successful recent British TV series Broadchurch.

Johannes Steurer, ARRI's Principal Engineer, comments:

"Experimental endeavors such as FascinatE help us continue a 96-year tradition of innovation here at ARRI. We are proud to be part of such a high-ranking consortium of European research institutions and subjecting our latest technologies to challenging applications. The fact that the ALEXA M has proved such a widespread success shows how worthwhile and inspiring research projects such as these

Figure 13. The ALEXA M in use where space is limited.

On todays' devices, such as HDTV screens and tablets, video with an ultra-high resolution (UHDTV) cannot be displayed in its original form. Furthermore, the bandwidth requirements for delivering this video to a variety of end user devices remains a challenge for todays' networks. TNO has developed new technologies for rendering of, and interaction with high resolution video. This tiled streaming technology enables video content originating from a source with ultra-high resolution, to be transmitted adaptively to different types of devices, such as smartphones, tablets and Connected TVs. The idea is to stream only that part of a video that the user is interested in, making optimal use of available bandwidth. TNO's tiled streaming technology is fully HTTP-based, leveraging existing Content Delivery Networks (CDN) for over the top Internet based delivery. Furthermore, it is aligned with current HTTP adaptive streaming solutions, such as Apple HLS and MPEG-DASH. All the intelligence resides in the mobile device, allowing for scalability to millions of devices without any server-side processing. All decoding is performed using a hardware decoder, saving battery life on the mobile device.

With tiled HTTP adaptive streaming, the source video is spatially segmented into a grid of independent video tiles. Each video tile is individually encoded and then temporally segmented according to any of the common HTTP adaptive streaming solutions. Tiles are temporally aligned such that segments from different tiles can be recombined to create the reassembled picture. For the mobile version of tiled streaming, an overlapping tiling scheme is used. The main advantage of having overlapping tiles is that the total number of tiles that are necessary to reconstruct a given Region-of-Interest can be reduced. This in turn allows for a reduced number of decoders, which is useful for mobile devices in which it is advantageous to perform decoding in hardware only. After the panorama content has been tiled using the overlapping tiling scheme, the resulting H.264 encoded streams are placed in individual MPEG2-TS streams. The resulting streams are then temporally segmented in order to be used with HTTP Live Streaming (HLS).

> *"The idea is to stream only that part of a video that the user is interested in, making optimal use of available bandwidth"*

iCOMBINE application

TNO has developed an application for Apple iOS devices that allows users to navigate around ultra-high resolution panoramic videos on their tablet or smartphone. Apart from navigation, the application features Record and Replay functionality. With the
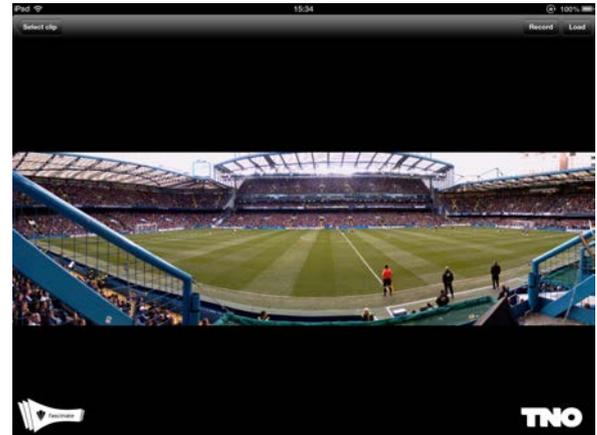

Figure 14. Panorama of Premiere League football in iCOMBINE application

Record function it is possible for a user to record all interactions with the content, creating what is effectively a user-generated navigation script. Using the Replay function, a user is able to call up a list of all scripts available. Upon selecting a particular script, all recorded navigation commands are played back synchronously with the content, providing a lean-back method of enjoying the full panoramic video. Recorded scripts can be shared with others, thus sharing the immersive experience.

For the Dutch Huygens exhibition in The Hague, an exposition chronicling the life and work of Constantijn and Christiaan Huygens, a special version of the iCOMBINE application was developed. With this application, it is possible for visitors to navigate around the universe through a series of high resolution photographs taken by various space telescopes. While the photographs consisted of static content instead of the video recorded by the OMNICAM, the huge resolutions of the photos presented a similar challenge to what is experienced when navigating through a panoramic video; the total bandwidth necessary for retrieving and presenting a single image is too large to be handled by a tablet device.
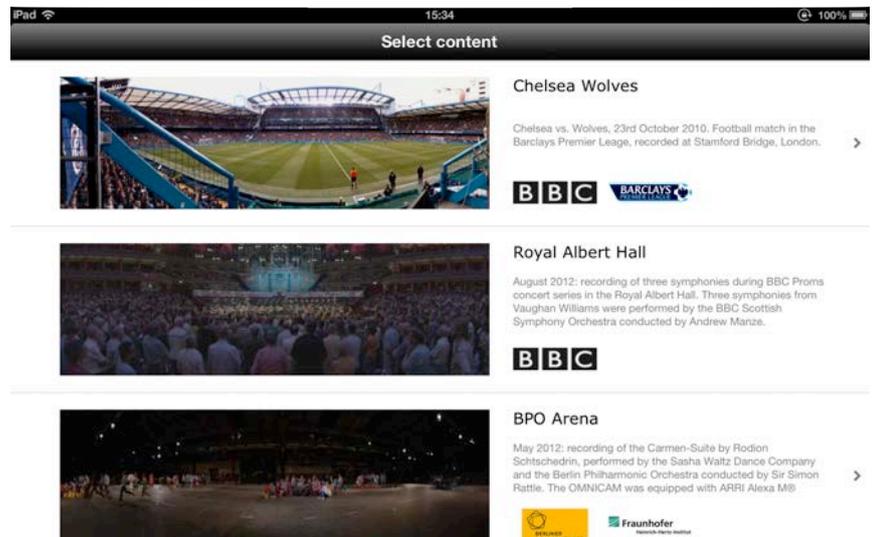

Figure 15. The iCOMBINE application

The FascinatE Project and Consortium

FascinatE is an EU-funded project involving a group of 11 partners from across Europe. FascinatE stands for: Format-Agnostic SCript-based INterAcTive Experience and has looked at broadcasting live events to give the viewer a more interactive experience no matter what device they are using the view the broadcast.

The **FascinatE** project has developed a system to allow end-users to interactively view and navigate around an ultra-high resolution video panorama showing a live event, with the accompanying audio automatically changing to match the selected view. The output adapts to their particular kind of device, covering anything from a mobile handset to an immersive panoramic display. At the production side, this required the development of new audio and video capture systems, and scripting systems to control the shot framing options presented to the viewer. Intelligent networks with processing components are needed to repurpose the content to suit different device types and framing selections, and user terminals supporting innovative interaction methods are needed to allow viewers to control and display the content.

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