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360–degree video
Case Technobothnia

Tietojenkäsittely
2017

UNIVERSITY OF APPLIED SCIENCES
Tietojenkäsittely

ABSTRACT

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Title	360–degree video Case Technobothnia
Year	2017
Language	English
Pages	35
Name of Supervisor	Päivi Rajala

The aim of this thesis was to study different types of 360-video cameras, virtual-reality glasses, 360-video platforms and the production of 360-videos. The study examined 360-video cameras and 360-video production from a beginner's point of view with the end goal of filming and producing, if possible, a high-quality 360-video of Technobothnia.

This was a qualitative research study and a development project, where a 360-degree video of Technobothnia was produced for marketing purposes. The development project was commissioned by the marketing department at Vaasa University of Applied Sciences as they would like to acquire a 360-video for trade fairs and digital marketing. Information for the theoretical study was gathered from internet-sources and device manuals.

For the production of the Technobothnia 360-video a Samsung Gear 360-videocamera were used together with a Samsung S6 and Google Cardboard glasses.

VAASAN AMMATTIKORKEAKOULU
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TIIVISTELMÄ

Tekijä	Richard Gustafsson
Opinnäytetyön nimi	360–degree video Case Technobothnia
Vuosi	2017
Kieli	Englanti
Sivumäärä	35
Ohjaaja	Päivi Rajala

Tämän opinnäytetyön tavoitteena on tutustua erilaisiin 360-videokameroihin, VR-laseihin, alustoihin sekä 360-videotuotantoon. Tutkimuksessa tarkastellaan aloittelevan henkilön näkökulmasta 360-videokameroita ja 360-videotuotantoa. Päämääränä on tuottaa 360-video opetus- ja tutkimuslaboratorio Technobothniasta. Tutkimuksen yksi tutkimuskysymys on: miten toteutan, jos mahdollista laadukkaan 360-videon Technobothniasta?

Tutkimus on kvalitatiivinen tutkimus ja kehittämishanke, jossa Technobothnialle tuotetaan 360-videomateriaalia markkinointitarkoituksiin. Kehittämishankkeen toimeksiantajana on Vaasan ammattikorkeakoulun markkinointiosasto, joka tarvitsee 360-videota hyödynnettäväksi messuilla ja digitaalisessa markkinoinnissa. Teoriaosassa on hyödynnetty aineistoa internet-lähteistä ja laitemanuaaleista.

Kehittämishankkeessa valitaan Samsung Gear 360-videokamera Technobothnian 360-videon tuottamiseen. Lopputuloksena on suunniteltu, toteutettu ja testattu Technobothnian 360-video, joka soveltuu kateltavaksi VR-laseilla.

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1   INTRODUCTION

In this thesis the main focus will be on 360-cameras and equipment needed to produce and view 360-content. A 360-video will also be produced alongside with this thesis. The 360-video is meant for the personnel of the marketing department at Vaasa University of Applied Sciences as they have a need of a video, which would be showcased to visitors at trade fairs.

Filming and producing a 360-video is not challenging when one possesses the knowledge and the hardware. But what happens when you look at things from a beginner's point of view? A beginner has neither the theoretical knowledge nor the practical experience with the hardware. This is one of the questions that will be discussed and studied in the Case study.

In the future it would be ideal if Vaasa University of Applied Sciences' marketing division's personnel are able to film and produce representative 360-videos themselves, for marketing purposes - for example from student events etc.

Qualitative research methods will be used in the study. This paper consists of several sections starting with an introduction followed by a theoretical study gathered from different sources as well as a practical study based on theory and observations. The results of the project development and conclusions are discussed at the end of the thesis. In chapter 2, 360-cameras are evaluated and in chapter 3 virtual glasses, head mounted displays and different areas of usage for them are discussed. In chapter 4 different types of 360-video platforms are studied whereas chapter 5 is the case study.

For the production of the video from Technobothnia a Samsung Gear 360-video camera will be used together with a Samsung S6 phone. The end product is a planned, tested and implemented 360-video which is suitable to watch on screens or with VR glasses

2   DIFFERENT TYPES OF 360-VIDEO CAMERAS

There are many different types of 360-video cameras. They are usually classified in several ways, for example, price, ease of use, field of use, type of camera lenses and the number of lenses.

A rough classification of cameras could be made in consideration with the technology they use. The most basic versions of 360-video cameras are the ones that film in 2D with a HD resolution of 1920*960. With these types of video cameras one can shoot moderate 360 still pictures - but recording 360-videos produces grainy picture, which is not acceptable when the aim is to produce a representable video. (Pänkäläinen 2016.)

The next category of 360-video cameras films with a 4K (3840*1920) resolution, which is a remarkable increase in pixels compared to the previous segment. The videos, created with these types of video cameras, have a fairly good quality and are a good choice for social media videos. The picture is reasonably sharp, but usually lacking depth. (Pänkäläinen 2016.)

The last category of cameras is mainly aimed at professionals and intended for professional use – mainly in the TV and the movie industries. The price range for these types of cameras starts from 1.000€ and can go as high as ~40.000€. (Pänkäläinen 2016.)

The most important thing to keep in mind when thinking about acquiring a 360-video camera is that it can come in many shapes and looks, but the one key feature is the resolution in which the video camera is able to film.

I have decided to divide the cameras into three categories: basic to intermediate, intermediate to advanced, and professional.

2.1 What is a 360-video?

Unlike a normal, flat video picture (standard television picture), a 360-video is much like the inside of a sphere, where the viewer is in the centre of that said

sphere, levitating and looking at the walls, the roof and the floor. This is possible because of the special equipment called a 360-degree video camera.

Unlike a normal video camera, which records what is in front of it and the recording then gets portrayed on a TV screen, or in a cinema - a 360-video camera films also what is behind, above and beneath the cameraman. All these pictures get stitched (or mapped) together into a sphere and, by using special head mounted displays (or virtual reality glasses), the viewer can see all the pictures at once, re-experiencing fully the moment, in which the clip or movie got filmed. The spectator can see everything in a spherical video, both horizontally and vertically, which makes a 360-video the perfect way to capture an experience. (Pänkäläinen 2016.)

2.2 Basic to intermediate 360-video cameras

Table 1. Basic to intermediate 360-video cameras (Daniel 2017).

Device/Features	Samsung Gear 360 2017	Samsung Gear 360	Insta360 Nano	Insta360 Air	Giroptic iO
Number of lenses	2xf/2.2 Lenses	2xf/2.0 Lenses	2xf/2.0 Lenses	2xf/2.0 Lenses	2xf/1.8 Lenses
FOV	Full 360°	Full 360°	Full 360°	Full 360°	Full 360°
Resolution & fps	4K 4096x2160 at 24 fps	4K 3840x1920 at 30 fps	3040x1520 at 30 fps	3008x1504 at 30 fps	1920x960 at 30 fps
360 Live stream	Yes at 2k	No	Yes	Yes	Yes
Stabilization	Yes	No	No	No	Yes
Storage	MicroSD 256GB	MicroSD 128GB	MicroSD 64GB	Uses phone memory	Uses phone memory
Battery	1160 mAh	1200	800 mAh	Uses phone battery	Uses phone battery
Compatibility	Samsung & iOS smartphones	Samsung smartphones	iOS	Android	iOS
Price	230$	109$	195$	130$	249$

Cameras vary hugely in price and the basic 360-video cameras' entry price can be as low as 100€. The table lists the most important features which are present in the 360-video cameras when priced under 250$ at the moment.

There are basically two different types of cameras as shown in Table 1. There are separated standalone video cameras, such as Samsung Gear 360, and cameras like Insta 360 and Giroptic, which need to be attached to a smartphone. All of the above video cameras come with two lenses which have a combined field of 360 degrees view.

When observing the different resolutions, it becomes evident that they vary all the way from a standard HD resolution to full 4K resolution, and what is interesting here is that the cheapest camera has almost the highest resolution.

2.3 Intermediate to Advanced 360-video cameras

Table 2. Intermediate to Advanced 360-video cameras (Daniel 2017).

Device/Features	Insta360 ONE	YI 360	Ricoh Theta S	360 Fly 4k	Nikon key
Number of lenses	2xf/2.2 Lenses	2xf/2.0 Lenses	2xf/2.0 Lenses	1f/2.5xfishlens	2xf/2.0 Lenses
FOV	Full 360°	Full 360°	Full 360°	Vertical 240° Horizontal 360°	Full 360°
Resolution & fps	3840x1920 at 30 fps	5760x2880 at 30 fps	1920x1080 at 30 fps	2880x2880 at 30 fps	3840x2160 at 24 fps
360 Live stream	Yes	Yes	No	Yes	No
Stabilization	No	No	No	No	No
Storage	MicroSD 256GB	MicroSD 256GB	Internal 8GB	Internal 64GB	MicroSD 128GB
Battery	820 mAh	1430 mAh	25 min rec.	1780 mAh	1050 mAh
Compatibility	iOS	Android/iOS	Android/iOS	Android/iOS	Android/iOS
Price	299$	399$	299$	297$	500$

Comparing basic to intermediate category with intermediate to advanced one can notice that feature-wise there is not a big difference. As shown in Table 2 the only camera, which stands out, is YI 360 with its superior resolution. Also, worth mentioning is that all cameras, except one, are compatible with both Android and iOS

– whereas, in the previous category, not a single camera was compatible with more than one operating system/platform.

2.4 Professional 360-video cameras

Table 3. Professional 360-video cameras (Daniel 2017).

Device/Features	VIRB 360	Nokia Ozo	GoPro Omni
Number of lenses	2xf/1.8 lenses	8xf/2.4 lenses	6xHero4 black
FOV	Full 360°	Full 360°	Full 360°
Resolution & fps	5.7K at 30 fps	8x2.2K at 30 fps	6x4K at 30 fps
360 Live stream	Yes	Yes	N/A
Stabilization	Yes	Yes	N/A
Storage	MicroSD 256GB	500 GB Internal	128 GB/camera
Battery	1h recording	45 min recording	1h recording
Compatibility	Android/iOS	Mac OS, Windows	Mac OS, Windows
Price	799$	40.000$	1300$

Table 3 shows the best cameras which, of course, also are the most expensive ones. Nokia Ozo is the flagship of 360-video cameras - it is meant for professional use and for the movie industry. (Savvides 2017.) There are also many different types of 360-cameras and setups, made out of several GoPro action cameras, put together. For example – GoPro Omni is composed of six GoPro cameras, while the most expensive GoPro based model, produced to date, is made up of sixteen GoPro cameras.

2.5 360-video resolution

One of the most important aspects regarding 360-video cameras is the resolution. The one used for creating 360-videos is quite different than the standard TV or computer screen resolutions. (Kintner 2017.)

360-videos are filmed in such manner so the viewer is in the centre and the video around him. This creates an immersive experience for the spectator, since he can look around, up and down. Even though a 360-video is a complete sphere with a 360-degree horizontal view and a 180-degree vertical, it is of utmost importance to understand that on most Virtual-Reality glasses the viewer can only see about 90 degrees at a time. "Viewing the entire sphere of the video involves the user turning and tilting their head and body. At any given moment, a viewer can only see about one-quarter of an immersive video – the slice of the image directly in front of them". (Kintner 2017.)

With the viewer being able to observe only one slide at a time (roughly 90 degrees horizontally and vertically), the resolution which this slide possesses will directly impact on the viewer's experience. If a video is filmed in 2K, with a 360-video camera, the resolution is, in fact, a lot worse than what it might sound like. This would mean that whichever slide or image is being viewed is seen only in 500 pixels width. This is almost a SD resolution - the same which old televisions were using in the 90's. To really emphasise the difference in resolutions, I quote Kintner: "Imagine the difference between a Commodore 64 and a brand new high definition 4K TV. That's a very visible difference." (Kintner 2017.)

To achieve a true 4K resolution would require each 90-degree slide to contain 4K pixels on its width and 2K pixels on its height. This would amount a total of 16.000x8.000, in order for the viewer to get a true 4K experience for the whole 360-video. (Kintner 2017.)

3   HEAD MOUNTED DISPLAY (HMD)

Users need a device to be able to view and enjoy 360-videos. This device is either a head mounted display (most of the times shortened to HMD) i.e. a pair of virtual-reality glasses (VR glasses), or a virtual-reality headset. There are many different types of head mounted displays on the market and, as with cameras, the price range varies from a few euros to hundreds of euros.

I will go briefly over the technology behind the HDMs while also discussing the most popular and widely used head mounted displays - and will try to shed some light over the type of displays, considered suitable for different types of scenarios.

One thing to keep in mind is that the so-called head mounted displays are nothing modern. Already in the 60s cinematographers started experimenting with the concept. They were investigating whether the user could get the video content beamed directly into his eyes, instead of the standard way movies were being watched in the cinemas, or from the couch at home. (Stobing 2016.)

There is, however, one major aspect, which makes today's HMD differ hugely from all previous attempts. Thanks to today's technology, the modern HMDs are eventually able to keep an accurate track of where the user is, and what the user is doing in the real world. All this data then gets translated into movement, or actions, which take place inside the video/game. (Stobing 2016.)

3.1 HMD or VR headset

What is the difference between all the various types of devices that can be found on the market? The main distinctions between HMD and a VR headset are in the experience they provide for the viewer. If the observer is sitting or standing still while watching a 360-video, then we are referring to the device as a "head mounted display". The viewer is semi-passive - all that is required from him is to tilt his head up and down, and to turn around, if he wants to look around inside the video. (Stobing 2016.)

If the viewer is actively taking part in the content that is being viewed - for example by jumping, walking, interacting with objects, shooting or dodging bullets - we are talking about virtual reality headset. (Stobing 2016.)

I quote Nick Pinos, a writer at techradar.com, and his excellent description of virtual reality:

"Imagine standing on the ledge of a 100-story building. Imagine looking down at the street below you. Imagine the tightening of your stomach and the sense of dread that you might, at any second, fall to your demise. Now imagine taking one step forward. You're falling and the world is whipping before you. You're petrified. But you also feel alive. The second right before you hit the ground is the worst – your brain is actually prepared for the moment by dumping adrenaline into your system as a mild painkiller. But while all this is happening, you haven't actually moved. You've been sitting in a chair in your own home, staring into a screen. Your biometrics have changed, but, geographically speaking, you're exactly where you were 10 minutes ago." (Pinos 2017)

3.2 Areas of usage

Aside the most obvious areas - such as gaming and entertainment, where HDMs are widely used - there are many more areas that directly benefit from using HMD.

3.2.1 Health care

Virtual reality became adopted quickly by the health care industry. With the assistance of the images, taken by an x-ray or ultrasounds, it is now possible to build complete 3D models of a patient's anatomy. Today these models help doctors and surgeons determine, amongst other things, the best way to locate tumours. Virtual reality is also a big factor in rehabilitation of stroke and brain injury victims, who need to regain their lost, or compromised, motor skills. (Stobing 2016.)

3.2.2 Space

Virtual reality is the perfect tool for NASA, during astronauts' practice for different types of missions in various unusual and even unexperienced before environments. What is it like to walk on the moon, live in a spaceship, repair a satellite in open space, or control a robot, searching for life on Mars? Astronauts can now

take part in all types of simulations, which will greatly increase the chances of the real mission becoming a success. (Ohannessian 2016.)

3.2.3 Culture

Instead of traveling around the world, in order to visit different museums, VR technology makes it possible for people to transport themselves instantly to the Louvre in Paris, the Guggenheim in New York and the Acropolis in Athens. (Stobing 2016.)

3.2.4 Military

Militaries often prepare and train soldiers with the help of virtual reality, before deploying them - and also maintain already gained variety of skillsets. Through simulations the soldiers can practice working together in a realistic surrounding. (Hsu 2010)

3.2.5 Marketing and branding

There have been several experiments with 360-videos vs. traditional videos, where the goal was to find out whether a 360-video would bring any added value to the consumer and would it yield revenues to the company. Google, together with Columbia sportswear, filmed two 60-second trailers with clickable advertisements, which were uploaded to YouTube. Both videos consisted of the exact same content - one being filmed with a 360-video camera and one with a traditional video camera. By clicking on the advertisement the user was able to view the full length video. (Habig 2016.)

The conclusion of the experiment was that - users viewing the 360-degree version were clicking more often on the ads, to be able to see the whole video. People also shared the 360-video at a much higher rate. (Habig 2016.)

As can be seen in this experiment - there is potential for 360-videos in marketing and branding. A well-made, intriguing 360-video, will not only catch the viewer's eye but will also very likely make them engage with the said video.

3.3 Most used HMDs and VR headsets

Table 4. HMDs and VR headsets (Greenwald 2017a).

	Sony PlayStation VR	HTC Vive	Oculus Rift	Google Daydream View	Samsung GearVR 2017
Headset type	Tethered	Tethered	Tethered	Mobile	Mobile
Connections	HDMI, USB 2.0	HDMI, USB 3.0	USB 3.0	None	USB 2.0 & 3.0
Resolution	960 x 1080 (per eye)	1080 x 1200 (per eye)	1080 x 1200 (per eye)	Native to phone	Native to phone
Refresh Rate (Hz)	120	90	90	60	Native to phone
Field of View	100	110	110	Not specified	101
Sensors	Motion, external visual positioning	Motion, camera, external motion tracking	Motion, external visual positioning	Motion	Motion
Controls	DualShock 4, PlayStation Move	HTC Vive motion controllers	Oculus Touch, Xbox One gamepad	Handheld remote	Handheld remote, touchpad on headset
Hardware platform	PlayStation 4	PC	PC	Google Daydream VR	Samsung Gear VR
Software platform	PlayStation 4	SteamVR	Oculus	Android	Android

There are many different types of glasses on the market, all coming with different set of features and area of use. I have, however, decided to focus on the most mainstream ones and on the bigger brands. Table 4 shows the specifications for each of them, followed by a more in-depth look.

3.3.1 Samsung Gear VR

Samsung headset, as shown in Figure 1, is a mobile headset, which means that all the processing happens on the users' phone - hence no cables are required and absolute mobility is fully achieved. The resolution of the videos is largely determined by the phone's own native such. Samsung flagship phone S8 comes with a

resolution of 2960*1440, which provides a very decent end result, for a mobile headset. (Greenwald 2017.)

The headset itself comes with a motion controller, which is a great add-on. There is, however, not many software, which support the motion controller. The potential is huge, however - as Facebook, Oculus and Samsung are continuously working on adding more possibilities for the controller. (Greenwald 2017.)

Figure 1. Samsung Gear (Greenwald 2017b).

3.3.2   HTC Vive

HTC Vive, as shown in Figure 2, is a product of a successful collaboration between HTC and Valve, with both companies benefitting from each other. HTC got to name the product - and Valves SteamVR is being used as the platform. HTC Vive makes it possible to turn one's living room into a virtual reality playing field.

Compared to other head mounted displays, HTC Vive shines when it comes to interacting with virtual reality environments, which is a main factor in experiencing the immersion. The Vive also gives the user more freedom to move around, because a whole room (5x5 meter) can be converted into a playground. (Hardawar 2016.)

Figure 2. HTC Vive (Greenwald 2017b).

3.3.3 Oculus Rift

In 2014 Facebook bought Oculus for 2 billion US$ and that was the start of a new division – Facebook Oculus VR. 2 years later Oculus Rift was ready to be shipped to consumers. (Orland 2014.) The headset is mainly aimed for the gaming industry, which got even more evident when they brand partnered with Microsoft which owns Xbox. A PC is still required to use the Oculus Rift but some games can be streamed from an Xbox One to the headset. (Kedmey 2015.)

The Rift is mainly known for its good design, more affordable price than its competitors, the low minimum PC requirements and a huge and continuously growing list of games, movies and applications. As shown in Figure 3 Oculus Rift headset comes with a pair of touch controllers. (Pino 2017.)

Figure 3. Oculus Rift (Hyde 2017).

3.3.4 Sony PlayStation VR

Unlike HTC Vive and Oculus Rift, PlayStation VR is purely meant for gaming and does not require a PC, it does however require the PlayStation 4 and a PlayStation camera which are not included in the purchase of the headset. According to several reviews, the picture is rather blurry. On one hand the resolution is lower than its competitors' ones, but on the other hand – it is also the cheapest of all the tethered headsets. Sony PlayStation Move Motion controllers, shown in Figure 4 have to be bought separately however.   (Thang 2017.)

Figure 4. Sony PlayStation VR (Co 2017).

3.3.5 Google cardboard

In 2014 Google revealed their first device in the VR segment, affordable VR glasses, made out of cardboard. They are compatible with both iOS and Android devices. Google cardboard can be bought at 15$ and is a good purchase if one wants to experiment or get introduced to VR yet not invest hundreds of dollars. Google cardboard, as show in Figure 5, does not come with a head strap, which means that the user needs to hold the device with his hands like a pair of binoculars. (Riley 2017.)

Due to the fact that you need to hold the device with your hands, I would rather call it a VR viewer instead of a VR headset. According to Riley (2017) Google

Cardboards are completely acceptable for shorter virtual reality sessions of gaming, or viewing videos.

Figure 5. Google cardboard (Google 2017).

3.3.6   Google daydream view

Google daydream view is the successor of Google cardboard. It goes into the mobile headset category and for a price of around 90€ one is getting a VR headset with huge potential. Unlike its predecessor Google Cardboard, which supported both iOS and Android, Google daydream view only supports Android. The headset is, according to Parker (2017) a real competitor to Samsung Gear. Google daydream view is not even trying to compete with the considerably more expensive full-blown VR headsets such as Oculus Rift and HTC Vive. (Parker 2017.)

Unlike Samsung Gear, which is built out of solid plastic, Google daydream view, as shown in Figure 6, is made out of soft fabric that forms accordingly with the viewer's facial features.

Figure 6. Google daydream view (Arici 2016).

4   PLATFORMS FOR 360-VIDEO

There are many platforms where 360-videos can be uploaded and viewed, each platform comes with different specifications and features. The target group itself and the type of video one has, will decide which type of platform is suitable to be used. In this project I will be using Facebook and YouTube as platforms, mainly because the video which will be filmed is a 360-video, not an immersive virtual reality video.

The social and sharing aspect is more important than interactivity. Vimeo and Littlstar are platforms which should be mentioned, because they come with features, which neither Facebook nor YouTube support for the moment.

4.1 Facebook

Facebook is a natural choice of platform, since one of the most important factors is exposure. With almost 2 billion monthly active users, Facebook is definitely the biggest platform and has lots of potential viewers.

Facebook has been supporting the playback of 360-videos since 2015 and it also supports resolutions up to 4K. The downside is that the video file size cannot be larger than 1.75GB. (Durrant 2017.)

4.2 YouTube

YouTube does not have as many users as Facebook, but it is still the number one platform when it comes to video content and engagement. Since with this video we are specifically targeting video viewers - YouTube is the "next to perfect" platform. Like Facebook - it also supports 4K resolutions, but the file size can be a staggering 123GB. (Durrant 2017.)

4.3 Vimeo

Vimeo is the second biggest platform right after YouTube, with and audience of 715 million monthly views. What is special about Vimeo is its resolution. Unlike Facebook and YouTube which only support 4K, Vimeo is supporting an 8K reso-

lution. This means that the viewer, in fact, gets a continuous, full HD experience. If the quality of the picture would the most important factor - Vimeo would be the obvious choice of platform. (Durrant 2017.)

4.4 Littlstar

Littlstar is a fairly new platform in the video platform business. It is a virtual reality network where the main focus, unlike other mentioned platforms, lies on 360-videos and virtual reality. Littlestar supports up to 4K resolutions and the best thing is that it is compatible with all existing virtual reality glasses and headsets. (Durrant 2017.)

5 TECHNOBOTHNIA 360-DEGREE VIDEO

Vaasa University of Applied Sciences marketing department was interested in acquiring a 360-degree video from Technobothnia in order to create marketing clips with it. The videos were to be shown to visitors at trade fairs. The initial idea came from Vaasa University of Applied Sciences former Marketing Manager Tarja Gromov. She visited a trade fair where she got familiar with 360-videos and Google cardboard glasses. It struck her that Vaasa University of Applied Sciences could very well use 360-videos for marketing purposes.

I completed my internship at the same department (Vaasa University of Applied Sciences marketing) and they were very satisfied with the result of my work. A few weeks after my internship, Tarja Gromov suggested/asked whether my previous work, a 360-panorama tour of Vaasa University of Applied Sciences, could be used as a 360-degree VR video. We contacted Jussi Loukiainen at Muova which is a design centre that acts as a link between the academic- and the business world, who has been working a great deal with videos and VR, and he told us that since the 360-panorama tour was not filmed with a 360-video camera - it cannot be done.

Tarja Gromov suggested we would get the equipment that is needed and we – or I – would write my thesis around a 360-video which would be filmed in Technobothnia.

5.1 Deciding on devices

In the beginning of January I had a meeting at Muova with Jussi Loukiainen and we had a long, thorough discussion. The topics were mainly revolving around how this project could be done, what the appropriate hardware should be, when the video should be filmed and who would acquire the hardware. The idea was to make a short video - or if needed several videos - about Technobothnia which would be as action-packed as possible. Jussi Loukiainen stated that Muova will acquire a camera for this project.

We decided that a Samsung Gear 360 camera would be acquired, since Jussi Loukiainen was already familiar with this camera and he thought it would suit this project nicely. Muova will continue using this camera once I am done filming, so there was no problem for them purchasing the Samsung 360 camera. Muova has however no use for a Samsung phone which is needed to control the camera.

I contacted Eliina Salmela (my contact person at Vaasa University of Applied Sciences) and we discussed different ways of acquiring a suitable phone. The camera requires a Samsung S6 or better, which costs around 300€. Eliina Salmela managed to get the IT-department to lease a phone for the purpose of this project.

5.1.1 Camera settings

The camera could either be controlled via its own buttons, or via the application Samsung gear 360 Manager, which could be downloaded from the Google Play app store. The phone and the camera are connected using Wi-Fi, Bluetooth and NFC. I have found this application to be useful and simple, but at times the connection between the camera and the phone has been slow and everything has been happening with a slight delay.

I will either be filming with a 4K resolution of 3840*2160 in 30 fps (which is the highest resolution the camera can film in), or 2560*1280 in 60 fps. Once the filming process starts, it has to be determined whether it is more important to get as clear picture as possible, or as smooth object movement as possible. The 4K resolution is the combined resolution of the 2 lenses, which means that the real resolution will be closer to 2K.

Even though the camera is round and has a lens on both sides, it is important to know which one is the front and which is the back lens. The images which are filmed with the front lens will automatically become what the viewer sees first in the video.

Jussi Loukiainen warned that the camera might overheat quite quickly. While I was practicing with it, the camera stopped filming several times and I had to let it cool down before continuing. I could also notice that while filming with the high-

est resolution, the camera overheated much more frequently and faster, compared to filming with a lower resolution.

5.2 Planning the filming

Together with Eliina Salmela we went to Technobothnia to have a look at the building, surroundings and the different types of equipment and robots. Technobothnia is an educational and research centre, where there is state of the art technology in use. The area itself is roughly $8000m^2$ and the equipment is mainly in the areas of electrical, mechanical and construction engineering as well as environmental and information technology. (Technobothnia 2017.)

I would not be able to film everything in the building for several reasons. First the camera I have in my possession tends to overheat quite fast, according to Jussi Loukiainen it could happen within as little as 10 minutes. Sadly the overheating problem is not a bug but a feature, which I have to work with and around.

Another reason is that it would be ideal if the camera could be stationary while filming. This presents a problem, since many of the objects that I am to film cannot be moved - hence I cannot film all the objects at the same time. If there is too much camera movement it might cause an unpleasant feeling for the viewer.

The camera would also have to be in close proximity to the action since 360-video cameras do not allow zooming. The height of the camera has to also be taken into consideration. If the camera is positioned wrong, either too high or too low, this can give wrong proportions to the objects, which are being filmed; they can be either too short or too tall.

We were able to narrow down a specific area in Technobothnia, which Eliina Salmela and I have agreed on focusing upon. This area has plenty of interesting action ongoing, throughout most of the time, and it would look good in a marketing video.

During a meeting with one of the teachers in Technobothnia, I asked him about his opinion on what would look good on film. He suggested using one of their ro-

bots, since it has wheels and can move around on its own, following pre-programmed directions. We would have to program the robot for it to move accordingly, and find out how we could attach the camera to it. There is a plain surface on the robot, where we could place the camera to stand using its own tripod. There is however, one problem - the robot shakes a fair amount, when it is moving because the floor at Technobothnia is quite uneven, and the end result might just be as bad as if a person were to walk around with the camera in hand.

Another thing the teacher suggested is to use some of his students to control a few robots at the same time. The camera would be placed between the robots on a tripod, or similar device. The robots, or robots' arms, would be moving around the camera doing simple tasks, while the camera is filming. This is so far the most promising idea.

5.3 Filming

When the filming started a problem presented itself right away. The camera would either film in 30 fps with a 4K resolution or in 60 fps with a HD resolution. This meant I had to choose from two not so optimal options. Either one would have a good resolution, which is well suited for videos in which there are not a lot of moving objects. It is preferred to film with as high fps as possible, whenever there are moving objects. This would make the recording be as smooth as possible, but then again the video will not be that sharp, due to the lower resolution.

During the recording process I have tried to film as much as possible, with both resolutions. In the editing stage this would provide the option to determine which of the 2 versions looks better and this way I would be able to at least partially, work around the problem. Still - there have been situations where I would have needed both the high resolution and the high fps together. Unfortunately this has been rendered impossible - I have been forced to make the best of the situation.

I decided to film several 20-30 second clips from different locations in Technobothnia with the camera being static. I could not come up with a good idea how to make it possible to move around in Technobothnia together with the camera. If

I were to walk with the camera on a tripod, or hold the camera above my head height - it would have caused too much shaking in the video.

The video will consist of around 10-20 clips with transitions in between the clips, to make the transition from one clip to the next as smooth, as possible. This way the end result will be a video, which will be in the 3-6 minutes range. The file size of the video might however appear too big for Facebook, since they only accept up to 1.75GB. If this turns out to be the case - I will have to make two shorter videos for Facebook. With YouTube this will not be a problem, since the platform accepts file sizes all the way up to 123GB.

5.4 Editing

Editing is done with Samsung's own editing program - Gear 360 ActionDirector. This program is included with the camera and is meant specifically for videos, filmed with a Samsung 360 camera. The video files are stored on the SD card in the camera itself. When the video files are imported to the program, they get automatically stitched together. All that is left for the user is to trim the video if needed, add transitions, add titles and upload it directly from the editing program to the desired platforms, to be viewed by audience.

5.4.1 Importing videos

When the camera is connected to a computer, on which Gear 360 ActionDirector software is installed, the user has to choose which type of video is to be edited - in this case a 360 VR Video, as shown in Figure 7.
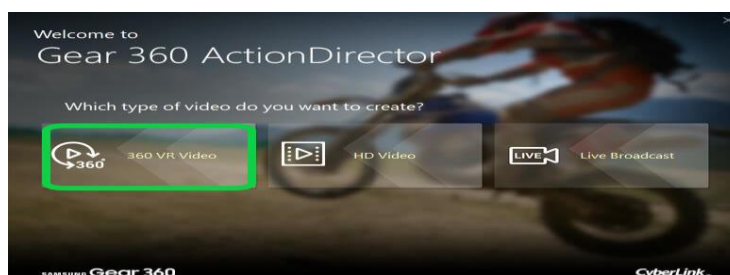

Figure 7. ActionDirector start screen

5.4.2 Main user interface

The main user interface is where all the editing takes place. In Figure 8 to the left (1) is the media room - all videos and pictures, which are imported, will show up here. Imported videos can be dragged and dropped on the storyboard (4). Once the video is on the storyboard, effects can be added, clips can be trimmed, titles and transitions can be included.

All the changes can be examined in the preview window (3), using the playback buttons. The audio which got recorded with the video, can be muted and – if required - background music (5) can be added to the storyboard. By pressing the produce (6) button, the edited video will get rendered and saved either to the computer, where the video is being edited, or to an online platform, if the user wishes so.
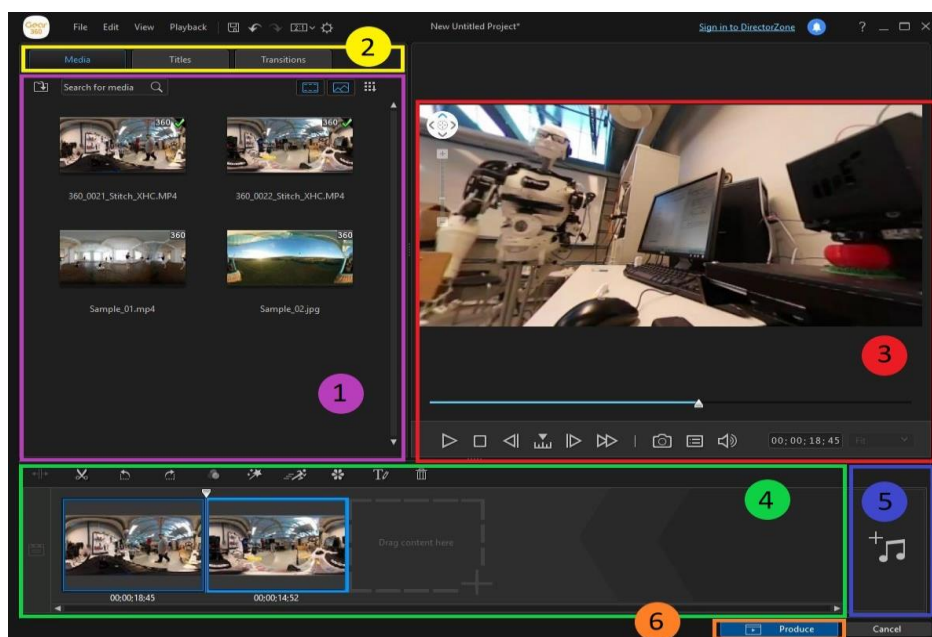

Figure 8. ActionDirector main window

5.5 Made public

When the test clips got uploaded to Facebook, they did not show up as 360-videos - they were only viewable as normal, flat videos. I had to download Spatial Media

Metadata Injector, in order to inject the videos with metadata, which informs Facebook, that this video is in fact a 360-video, instead of a standard flat video. At this stage the videos, which had been injected with metadata, behaved as they were intended to behave on Facebook. The viewer could now drag and zoom inside the video with the mouse cursor.

5.6 Final thoughts

Finding good material to film with a 360 camera is challenging, figuring out which scenes and objects are suitable and benefit from being filmed with a 360 camera is even more challenging. Based on my experience it all depends on what you are about to film, there are things where a 360 camera is to be preferred over a traditional camera. If there is however something specific you would like the viewer to see or if you want to tell a story with the video, then of course a traditional camera is the obvious choice of camera. There is basically no directing, when filming with a 360 camera, since one cannot predict what the viewer will be looking at.

In my opinion the one area where 360 cameras shine compared to traditional cameras – is its superb delivering of unaltered experiences, which the viewer can relive. Filming from a concert hall or a stadium, Christmas Eve and the moment of Santa's arrival, a hill top, a rollercoaster, or underwater - basically anything that is action packed- has lots of people around, or just offers a stunning view.

There are many areas where a 360 camera can be used for fun or for educational purposes as well. The camera can, for example, be placed inside a bee hive to see how honey is being made. Unlike with traditional cameras – "outside the box" type of thinking is not only good, but highly required, from what I have encountered.

Aside the actual video filming with a 360 camera there is also the aspect of the camera's ability to take excellent 360-photos. Instead of bringing a system camera with a tripod - with the pressing of just one button - a 360-photo gets taken. With

a system camera you need to take 4-6 photos from different angles and the pictures have to be stitched together using several programs.

Basically, all the affordable for private usage 360 cameras which are available on the market today film with quite low resolution and fps. On the good side, they are small, they can fit anywhere and are fast and easy to setup and use. 360-cameras and videos are still a fairly new phenomenon and it is going to be interesting to see what the future has in store for us.

6   CONCLUSION

The goal of this thesis was to find out which 360-degree video camera set up would be most suited for producing a short marketing video for Vaasa University of Applied Sciences. The task in addition to creating the said clip was to ensure the whole process of filming and uploading the video would be as simple and smooth as possible. This way the personnel at Vaasa University of Applied Sciences could themselves possibly film clips for social media in the future.

In this project a Samsung Gear 360 video camera was used, together with a Samsung S6 phone. All editing was done with Samsung's ActionDirector. If one already owns a phone, which is compatible with Samsung's Gear 360 video camera - then this is a very good setup, if the goal is to produce short videos for social media, or for own usage. However, for professional assignments I would advise looking into different types of 360 cameras or traditional video cameras.

Producing the video for Vaasa University of Applied Sciences was more challenging than anticipated. The intended location where the film was to be shot had many small areas connected to each other with narrow hallways - closely resembling a maze. Moving while filming with a Samsung 360 camera is not optimal, since the device does not come with a stabilizer. The final product consists of several shots from different locations, which are put together into a longer video, with the help of transitions in between the clips.

According to my own observations I would say that a 360-degree video can indeed offers added value to a marketing video compared to a video that is filmed with a regular video camera. 360-degree videos are excellent at delivering experiences to people. Filming short clips from student events, for example, which then get uploaded to social media sites, is something that that I would recommend for the personnel at Vaasa University of Applied Sciences.

The film which was made during this project is suited both for social media and to be showcased at trade fairs. The end -product meets the criteria that were given for the project. For future studies I would, however, recommend using a different type of camera. A robot on wheels that can be programmed to move freely around in Technobothnia together with a camera should be able to film very interesting material.

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