RESEARCH AND DEVELOPMENT ON VIRTUAL TOURISM AS AN EMERGING MARKET

NORD-FOSEN UTVIKLING AS

RAA, SEBASTIAN SKOGEN

Abstract

The note at hand is written with the objective to assist the Norwegian district Åfjord in assessment of virtual tourism as a potential candidate for entrepreneurship. It is all part of a larger project aiming to stimule jobs creation and economic growth in rural areas. Virtual tourism has been slowly growing over the years, with a recent increase in interest due to the ongoing pandemic. There are many different solutions for virtual tourism, though 360 imaging is the most widely used. While virtual tourism products have commonly been deployed to showcase traditional physical attractions, resent developments have been making a push for more standalone experiences. The subcategory of three-dimensional virtual truism (3DVT) is found to be promising way to follow these latest developments. Innovative technologies such as AR, MR, and VR, in conjunction with 3D computer graphics, are all promising tools for the field for 3DVT. Unlike 360 imaging, examples of solutions for 3DVT can be hard to find as the term is yet to be widely used. With much in common, the much more established industry of game development does however offer a lot of useful insight. The current console and PC gaming market suggesting that potential implementations of 3DVT could prove to be popular among the masses. Furthermore, alongside this note a demo is developed, showcasing that it is possible to recreate something that resembles a selected physical location on a relatively small resource and time budget. While 3DVT show promise, it is not without its fair share of obstacles to overcome. These include availability of the necessary the hardware, visual features and social features. Additionally, one has to select a clever business model and method of marketing.

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Imagine being at your dream destination, enjoying the spectacular views, the unique cultural features and the people behind it all. Take the Norwegian coast as an example. Characterized by a rich history of fishing villages and small farms located behind islands and many skerries; offering shelter from the harsh Northern Sea. You are experiencing all this from the comfort of your own home. No need for worrying about booking expensive flights, finding somewhere to stay or the environmental impact typically associated with long distant travel. You just pick your destination of choice. This is what virtual tourism is aims to be. It is now all coming together with new emerging technologies, being continuously improved, providing a range of new possibilities.

Although virtual tourism is not a new concept, it is still only at early stages with an underutilized potential. Moreover, the current COVID-19 pandemic has shed light on an industry that is known to be vulnerable at times like these. This fact has awakened new interest in the field.

This note will discuss virtual tourism from a perspective of the future. By the end, hopefully it will become clearer how current offerings look like and how they could be improved upon. Furthermore, an attempt will be made to indicate the potential in the market forwards. In addition, potential consumers and target audience, as well as ways of monetization will be discussed. Alongside this note, a demo is developed as a concept, showing how virtual tourism could be implemented.

BACKGROUND

In response to the need for restructuring of workforce in the Norwegian district Åfjord, as reported on by the consequence analysis on possible closure of Kråkøy Butchery (1), the research and development project on virtual truism was initialized by Nord-Fosen Utvikling. This is one of the measures taken in hopes of stabilizing and creating new innovative job opportunities in the rural area by stimulating both entrepreneurship and economic growth.

At the same time, the project is to align with the European initiative *Smart technologies for transforming social rural landscape empowered by big data-based platforms and ai Services* (SMILES), in which Åfjord district has taken part of. The initiative has the objective to "*boost rural economies through cross-sector digital service platforms"* (2).

Following the ideas of SMILES, the R&D project at hand first and foremost intends to provide economic stability to rural areas and offer an environmentally friendly alternative to traditional international travel. All this will be achieved through collaboration between different industries and cutting-edge technologies.

WHAT IS VIRTUAL TOURISM?

Virtual tourism is a broad term used for everything that facilitates a tourist experience that is created artificially. As Dr. Hayley Stainton defines when discussing the topic: *"virtual tourism is the use of technology to artificially enhance or create a tourism experience"* (3). Typically, it will be closely associated virtual tours, which simulates touring of an existing location using digital media like images and sound. In the industry of tourism, promotional material enticing tourists and historical preservation are among the most popular uses seen to this date (3). However, the field are gradually evolving into larger standalone experiences. The infographic by Tourism Teacher in Figure 1, illustrates this growth. Virtual tourism experiences can make use of a wide range of different medium. However, stereoscopic 360° imaging viewed either through a headset or simply on a traditional screen are the most used (4). Perhaps the most well-known example of a product like this, is Google earth with its Street views.
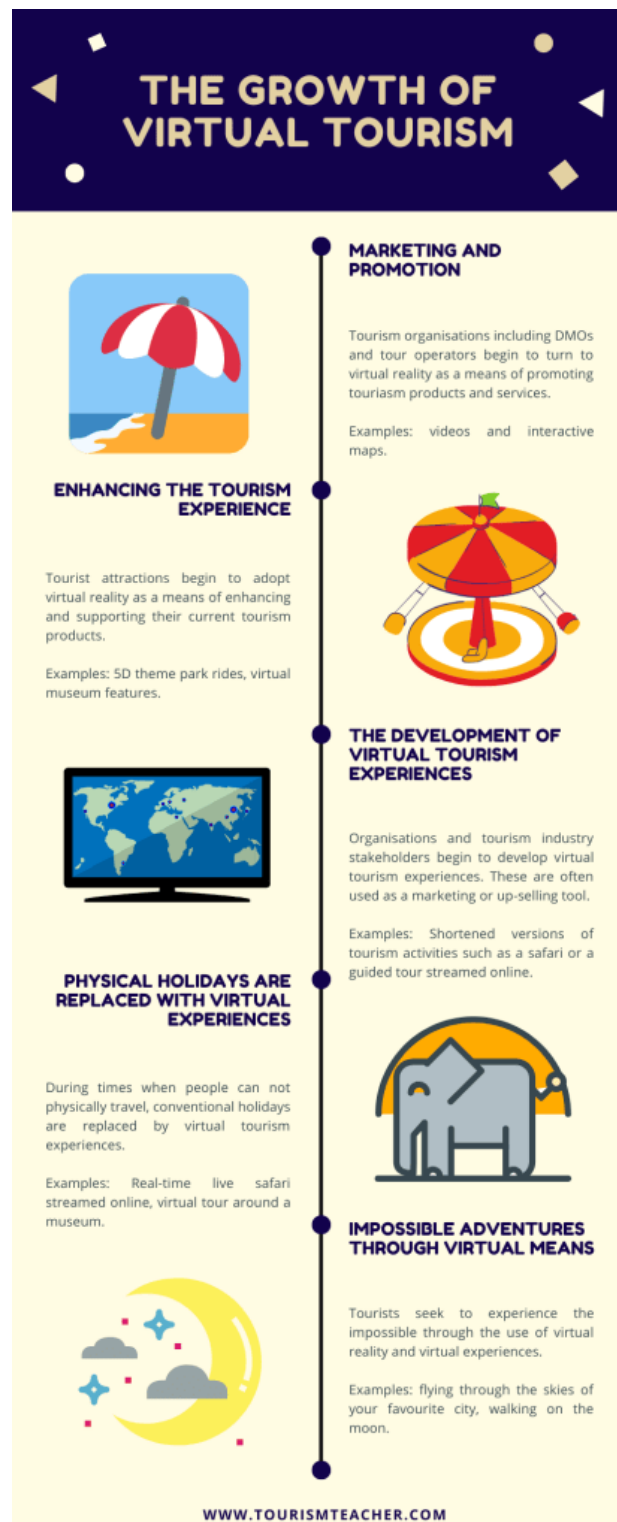

THE GROWTH OF VIRTUAL TOURISM

ENHANCING THE TOURISM EXPERIENCE

Tourist attractions begin to adopt virtual reality as a means of enhancing and supporting their current tourism products.

Examples: 5D theme park rides, virtual museum features.

PHYSICAL HOLIDAYS ARE REPLACED WITH VIRTUAL EXPERIENCES

During times when people can not physically travel, conventional holidays are replaced by virtual tourism experiences.

Examples: Real-time live safari streamed online, virtual tour around a museum.

MARKETING AND PROMOTION

Tourism organisations including DMOs and tour operators begin to turn to virtual reality as a means of promoting tourisam products and services.

Examples: videos and interactive maps.

THE DEVELOPMENT OF VIRTUAL TOURISM EXPERIENCES

Organisations and tourism industry stakeholders begin to develop virtual tourism experiences. These are often used as a marketing or up-selling tool.

Examples: Shortened versions of tourism activities such as a safari or a guided tour streamed online.

IMPOSSIBLE ADVENTURES THROUGH VIRTUAL MEANS

Tourists seek to experience the impossible through the use of virtual reality and virtual experiences.

Examples: flying through the skies of your favourite city, walking on the moon.

WWW.TOURISMTEACHER.COM

Figure 1: An infographic illustrating the evolution of virtual tourism (3).

In the coming years, it is predicted that VR[1] as well as MR[2] and AR[3], will rise in popularity (3). This is facilitated by computer graphics and hardware solutions being developed to become more powerful and easily accessible. All these technologies will apply some sort of Three-dimensional virtual tourism (3DVT). As the name suggests, it allows users to *explore the physical world by 3D geovisualisation of virtual environments* (5). These environments are recreated digitally using technologies such as 3D modelling and photogrammetry. Different from the common methods, it allows for interaction and greater sense of depth. Coming together with different media such as sound, it archives elevated immersion for the user. These types of solutions will be the focus of this paper onward.

FAMILIARIZING WITH THE CURRENT SITUATION OF 3DVT

Finding relevant work for the field of 3DVT can be challenging as the term are yet to be widely adopted. However, as the following sections show, it clearly exists out there when looking more broadly.

PREVIOUS WORK DONE IN 3DVT

As this note is written, there are only a handful of products made specifically for 3DVT. Most examples are recreation of historical sites; which allows for exploration of buildings that either do no longer exist of are under restricted public access. Rome Reborn might be the best example of historical site recreation. The product is described as an "computer reconstruction of the buildings and monuments explained to you by leading experts bring the city to life" (6). The digital recreation of the city has been in development since 2007,

Figure 2: Rome Reborn represent the result of a many years of work digitally recreating the city at its prime in a virtual world (6).

making it possible to explore the now vanished ancient city at its prime in VR.

In recent years, there have been some activity among small studios that have found their niche in 3DVT. The small studio Caves RD are among the most notable. The studio has recreated three popular tourist attractions from the real world, with Mýrdalssandur at Island being the latest addition. Each of these destinations are described as a simulator and allows for the player to explore the environment and take pictures (7). The latest environment is possible the most realistic made within 3DVT at time of this note being written. A video demonstration can be watched here.

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[1] Virtual reality (VR) is described as *"a simulated experience that can be similar to or completely different from the real world"* (23). The implementations can be identified by exclusively taking place in the virtual reality.

[2] Mixed reality (MR) is described as "*the merging of real and virtual worlds to produce new environments and visualizations"* (25). The implementations are identified by not exclusively taking place in either the physical or virtual world.

[3] Augmented reality (AR) is described as *"an interactive experience of a real-world environment where the objects that reside in the real world are enhanced by computer-generated perceptual information"* (24). The implementations can be identified by interactions taking place in physical reality.

**Figure 3: The game Mýrdalssandur, Island lets the user explore
stunning nature as a photographer (7).**

Other than being difficult to find, a reason for the lack of examples in the field of 3DVT could be due to high development cost causing lower quality than what users have gotten used to from the game industry. Another could be that the prerequisite needed simply wasn't in place. Either way, it leaves much room for further development.

PARALLELS TO THE GAME INDUSTRY

When looking for relevant work in the field of 3DVT, it is natural to look at the game industry as there are much overlap in the technology and implementation needed. This is a much more mature industry relative to the one of 3DVT and are where most of the current capital is for interactive virtual experiences. Besides, it isn't uncommon for tools originally developed for games to also be used for other applications. As a matter of fact, in recent years companies traditionally working in the game industry have made a push for targeting other industries as well. Moreover, applying principles of game design theory will also be useful for adopting new users.

LESSONS TO BE HAD FROM POPULAR GAMES

The game industry has been quite successful and grown into the current huge economic sector that it is. Reportedly, it is expected to generate sales of US$160.5 billion (1.5 billiard NOK) worldwide in
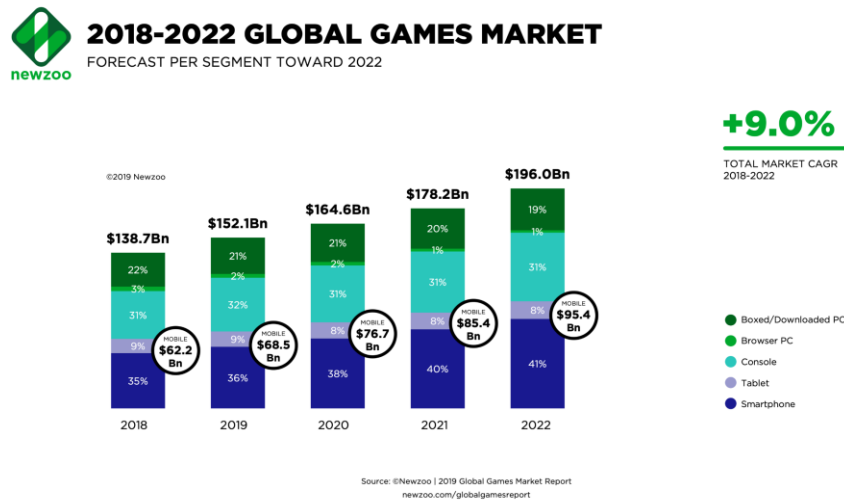
Figure 6: The graphs show predicted development of the global gaming market as reported by Newzoo (22).

2020 (8). Considering these figures, it is useful to investigate how games overlap with 3DVR and to indicate consumer popularity. For starters, take the games that portrays real-world locations. There are quite a few of these, commonly of the type referred to as *open world games*[4], allowing for exploration much like tourist. Some of the best examples of games taking place in urban cities include the Grand Theft Auto 5 (GTA5), Marvel's Spider-Man, the Watch Dogs series and the Assassin's Creed series.

Figure 5: With the eleventh instalment Assassin's Creed Odyssey takes place in the Peloponnesian War between Athens and Sparta (16).
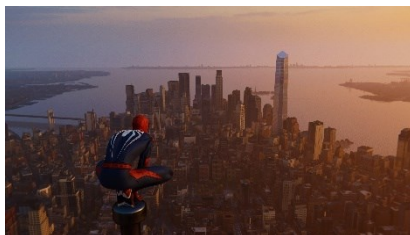
Figure 4: Marvel's Spiderman lets you swing through the modern city of New York (15).

Although often more liberal in their recreation, there is also decent selection of games more known for their landscapes of nature. Examples of such games are Red Dead Redemption 2 (RDR2), Far Cry series and Battlefield V. Each of the mentioned games are titles exclusively developed for the PC and game console platforms. Mobile platforms currently do not offer similar experiences with massive open worlds and photorealistic visuals, main reason being that it is inherently expensive on computing power. The

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[4] For videogames **open world** is described as a game mechanic of using a virtual world that the player can explore, and approach objectives freely, as opposed to a world with more linear and structured gameplay. Typical these games have huge levels; only at the bounds of an open-world game will players be limited by geographic features like vast oceans or impassible mountains (14).

fact that these are all AAA-games[5], are particularly interesting as it shows how appealing the genre is for game industry. It also suggests that these types of games are expensive on resources for development. Traditionally, this has been true for the most part, as it naturally involves a lot of manual labor. With resent development in procedural methods however, the process has been accelerated considerably.

Figure 4: Image captured within the game RDR2 on PC showcasing the vast landscape open for exploration.

Out of the bunch, GTA5 and RDR2 by Rockstar Games are perhaps the most relevant to 3DVT. This comes as they are well known to offer a *sandbox* experience, where its mostly up to the player to do what interest them the most. This is facilitated by a lot of attention to details in the digital worlds with the freedom to do almost anything one could want, including tourism activities. In the game RDR2, the different activities include everything from fishing, hunting, hiking, row a boat down the river to robbing a bank or finding a hidden treasure. More interesting this becomes, when considering these being one of the most soled games of all time. The two games are currently ranked as number 2 and 14, with sales of 130,000,000 and 31,000,000 respectively (9). Although both tops the lists when it comes to development costs as well, these numbers really speak for the potential in development of 3DVT taking the same ideas and concepts into consideration. However, it must be noted that these games are typically most successful when scaled up. To elucidate, GTA5 has become famous for costing US$137 million in just development, while also generating $815 million in worldwide revenue within 24 hours of release (10).

When looking at fictional games as well, there are a lot more games that could be seen relevant for 3DVT. Other than the many open world games, there are also a variety of games that focus on linear exploration. These are usually supported by some sort of story and set of tasks that encourage the player to progress. How active the player is expected to be in both story and tasks can vary a lot from game to game. The players involvement includes everything from deciding how the story will go to taking on some challenging activity. At the same time, there are simpler games such as Journey. This exploration
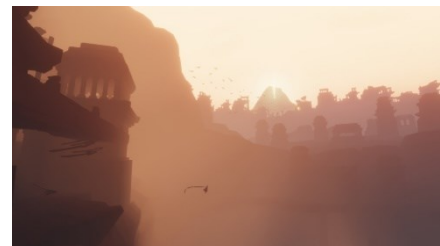

Figure 7: Journey is a game known for its visual and auditory art as well as the sense of companionship created by playing along a stranger. One can only communicate through musical chime, which create a calming atmosphere. (17).

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[5] The **AAA-Game** informal classification is used for video games produced and distributed by a mid-sized or major publisher, typically having higher development and marketing budgets (20).

game is almost entirely engaged by visuals; where stunning views are artistically presented. In fact, games like this with beautiful scenery sparks a lot of interest in what's known as in-game photography. If the player is facilitated with the tools needed, it allows for a lot of engaging creativity. The different ways on encouraging exploration throughout the virtual world are all valid when considering how to implement 3DVT. However, a carefully balanced mix is probably best if one wishes to attract different types of people.

Figure 9: The Climb is a VR game that lets you experience being a real climber (18).

Another interesting category of games for discussion are simulators. The concept is simple; simulate an activity from real life as best as possible by digital means. This type of game is typically very much specialized in a specific activity. In this way, the developers dedicate all their development in making it as real as possible. Furthermore, these often utilize VR headsets to further enhance the simulation. The climb is an excellent example of a game that relies on VR to immerse the user in the experience of climbing up tall mountains. These games show that there is a market for real life activities in a digital form.

**Figure 8: Competition winning picture taken within the game RDR2 (26).**

THE CUTTING EDGE OF TECHNOLOGY

When looking at developing a 3DVT product for the future, where others have yet to succeed, it is important to have an idea of what is at the forefront of possibilities. This might just prove to be that which is needed to succeed. When talking about 3DVT, improvements in technology such as computer graphics are among most prominent.

When talking about computer graphics, one might refer to *good graphics* as visually pleasing. In the case of 3DVT, the level of realism will commonly be a used interchangeably, as a realistic representation is desirable when attempting to capture the beauty of the real world digitally. Game engines are a central topic of this discussion.

Today game engines have almost become synonymous with real-time graphics or rendering. This comes as rendering at a high enough speed is necessary for creating the illusion of movement when the player interacts within a game. When talking about 3D rendering, one refers of the prosses of producing a raster image based on three-dimensional data stored on the computing memory (11). In this process, the graphics processing unit continuously converts 3D wireframe, light and color data into 2D images delivered to the users' device. A High-level shader pipeline is represented in figure 2. The game engine is what facilitates developers to utilize this power of real-time graphics and offer tools for game designers to program and plan out a game quickly.
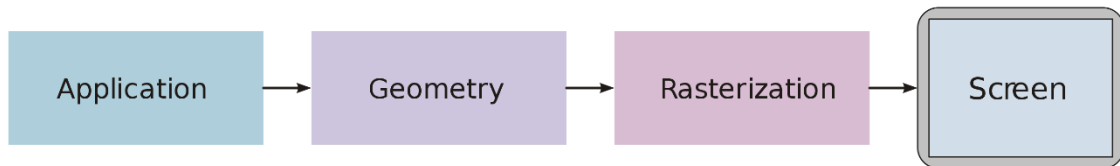
Figure 10: An overview of the graphics pipeline divided into three main parts: Application, Geometry and Rasterization (19).

For 3D graphics the main game engines of choice are Unreal Engine 4 (UE4), Unity, Godot, CryEngine and Lumberyard. As a side note, there also exist many more proprietary engines that are locked down to different studios. These are all capable engines, however UE4 and Unity are the most popular. In recent years UE4 have seen the most attention with great founding from success such as Fortnite. Furthermore, their upcoming UE5 promises great improvements to real-time global illumination and high poly handling as demoed in its reveal video (12).

With the risk of oversimplifying, here is a list of some "buss words" for technologies used in development of high graphical fidelity:

Table 1: Techniques used for creating cutting edge graphics

Category	Technology/method	Note
Geometry	Photogrammetry	Achieves natural looking 3D models with high resolution wireframe. Very useful for capturing the complex forms of objects from nature.
Lighting	Raytracing	Currently gives the most natural-looking lighting by simulating "light rays" from emitting sources. Can be performed in real-time, is however very taxing on computing hardware.
	Real-time Global illumination	Lighter alternative to raytracing utilizing estimations. Useful for light-sources such as the sun.
Physics	Dynamic and interactive water	Allows for water to react to interacting waves and objects in real-time. Often combined with simulating bouncy. Useful when a lot of player interaction take place around water, can however be taxing on computing hardware.
Effects	Volumetric particles	Densely populated particle points occupying an actual volume that interacts with lighting. Useful for creating light shafts in fog and clouds.
	Dynamic foliage	Giving foliage the ability to dynamically react to player interaction and wind.

	Dynamic weather	Makes it possible to for weather to change on the fly. Useful for giving a sense of time passing or for artistic purposes.
	Dynamic fur	Simulate fur reacting to animal movement dynamically.
Postprocessing	Ambient occlusion	Adds shadows where 3D objects are in contact. Both estimations and raytracing can be used. Useful for making objects less "separated".
Shading	PBR material	*Physically-Based Rendering* systemically divides materials into different distinct features, such as roughness and metalness. Best results are given with photogrammetry and procedural generation.
Audio	Bioneural	When audio is mastered for human anatomy. Typically recorded using two microphones separated about the distance of human ears or simulated as such within the game.

AN OVERVIEW OF THE DEMO

As mentioned, a demo is made to demonstrate how a virtual tourism product could be made for the Norwegian district Åfjord, or more specify the small coastal village Bessaker. Moreover, the demo is made with 3DVT as its target. With only a few weeks of development, the implementation focuses on level design and are intended as a concept for further development. This means that gameplay opportunities are scarse, however it allows for further such additions down the line. That being said, it is possible to explore the environment as an virtual tour, simular to the game Mýrdalssandur, Iceland.

The choice of engien fell on UE4 as this offered a lot of convient tools such as Quixel Megascans; a free to use asset liberary with lots of photogrammetry scans. The landscape is made using heightmap and depthmap exported from 1DTM and 50DTM service resectivly offered by GeoNorge. This data where also used of by the large studio EA DICE when recreating places such as Lofoten and Larvik for their game Battlefield 5 (13). Additional adjustments where made using Blender and Photoshop. In its entirety, the landscape has a total area of $20.17 \times 20.17 \mathrm{km}^2$. This is achieved using UE4's world compesition feature, where the landscape is devided into 5×5

Figure 11: The game Battlefield 5, a first-person shooter set in WW2, current have the most comprehensive attempt at recreating parts of Norway for interaction in an 3D environment.

tiles dynamicly loaded based of the players posistion. Furthermore, it makes use of a various precedrualy methods for such as placement of grass and foliage, and automatically blended surfacematerial based on gradient. Where the grass and foliage has the option to interact with both wind and objects.

As for the controllable character, it allows for both first- and third person perspectives. Moreover, it is set up to be able to climbe up and over different types of obstacles one might face. The demo has omitted support for VR, nevertheless it could added down the line with some preformance optimizations. Additional features include ocean with simulation of waves and bouyancy, volumetric clouds and fish swimming around.

Figure 12: Recreation of the island called Børøya in Bessaker with possiblility of exploration.

FURTHER DEVELOPMENT

There are many ways of taking virtual tourism in the future, with much unexplored. For this to take place there are measures that could be initiated to ensure serious development. One prerequisite might be to defragment the current offerings on the market. This could be accomplished by establishing platforms for different developers to distribute their products. Such platforms would possibly make it easier for smaller contributes to share their local experiences as well. Furthermore, encouraging more cross industry collaboration could prove to boost development and saturation of the market. In the field of 3DVT, the game and tour operator industries are examples of likely candidates. On the topic of 3DVT, some sort of initiative to contribute assets such as photogrammetry scanned models, audio and GIS data from different biomes made easily accessible, would help increase output of products. Moreover, it would encourage development for the corresponding areas. Not least does virtual truism need to become an established concept on the minds of the customers, and especially 3DVT.

THOUGHTS ON 3DVT BEYOND THE DEMO

Besides being used for demonstration purposes, there are quite a bit of more work needed for it to be shipped and marketed as a polished product for the masses. What such a 3DVT product would look like is up to the future innovators, as there is yet to be a proven product out there. However, here are some ideas.

First and foremost, there would likely be higher probability of success if one does not limit ideas to traditional tourism. Naturally it is very difficult to implement a complete replica of the physical world. Instead, embrace the nature of a digitally created virtual environments. When not limited to the laws of

real life, suddenly it is possible to visit earths most inaccessible areas, control time and weather, or just fly up in the clouds among the birds. It also has the potential to become much more affordable and a part of everyday life. In this sense, 3DVT could be more of a competitor to entertainment such as movies and games, while also having aspects satisfying the desire to travel the traditional way.

Figure 13: Valve Index are currently considered to be the best consumer VR Headset. A full set will set you back USD$1,000 and moreover it has limited availability as well.

Secondly, there are some core technical challenges that must be overcome for wide adoption. These issues are summarized in table 2 below:

Table 2: Summary of technical issues to be solved

Issue	Description
Visuals	A visually satisfying experience are likely necessary for attracting attention. In other words, time must be invested in refining the visual and new graphic technologies must possibly be incorporated. This could be achieved by recruiting game developer artists as well as engineers and utilizing tools such as the upcoming UE5 engine.
Hardware	Widely available and enabling hardware are needed ensure an affordable and immersive experience. When the graphical fidelity is to be elevated, so does the demand for capable hardware. Currently the required hardware for delivering photorealistic visuals is too expensive to expect any other than some enthusiast of owning. This could be solved by unitizing or developing next-gen VR and computational hardware.
Socials	Implement and integrate multiplayer and social media features to create shared experiences as well as acuminate traction of new users. Memories are best when shared with others and allow for repeatable unique experiences. Being able to connect with people in new and fun ways attracts the masses. This requires establishment of dedicated servers and integration with various social media APIs.

THOUGHTS ON BUISNIESS MODELS AND TARGET AUDIENCE FOR 3DVT

When developing innovative solutions for such as 3DVT, it is important to do so with a sustainable business model and a clear target audience in mind. Afterall, this is what really determines its success in the long run. The simplest way is probably to sell the products standalone experiences for different destinations on various well-established game stores such as Steam and Oculus store. This is already the most widely adopted way of doing things. The main audience using this model are likely to overlap with those of video games. Although, as these stores might be crowded with other products

and are not really made with 3DVT in mind. For this reason, establishing a dedicated platform could be considered. This way it would possibly become more marketable for non-gamers as well.

Much like the movie industry, one might have to rely on dedicated services to offer the necessary hardware in early stages. There are already a few of these popping, where one can show up and pay to play through an VR experience of choice for a limited time. Building upon the concept, one could perhaps make exclusive or early excess product for these services. The target audience in this case would be diverse, however mainly a younger generation living in larger cities.

Following the path of the movie industry, a subscription model could become a viable solution. Like similar services such as Netflix and HBO, a continuously updated selection of experiences is offered for a monthly payment. In fact, Viveport is an example of a service that already exist for VR games. Furthermore, assuming solutions such as Google Stadia and Nvidia Now for providing remote hardware advance considerably, adoption could become easier for a wide audience. Moreover, adoption of a service like this could provide a stable income and encourage regular usage.

As completely different direction, one could enter a collaboration with nursing homes and hospitals. For various reason, this might be the patients only possibility of travelling and experience the world outside. Solutions for 3DVT could help them both connect with people and improving mental health.

Finally, a wide adoption of 3DVT would of course not be very popular among the people who depend on traditional tourism as their main source of income. Therefore, a way of incorporating these people ether by contributing content or just a monetary compensation form earnings would improve acceptance. This is also a great opportunity to stabilize their income, making it less season dependent.

CONCLUSION

To conclude, how does the market of virtual tourism stand for the upcoming future? Virtual tourism clearly has its place in times of a pandemic; however, it is desirable for it to position itself as an independent product to become a viable industry. With simpler solutions such as 360° imaging already being well established, there are much more potential for innovation in 3DVT. Moreover, the demo developed alongside this note, shows that relatively quick recreation of physical locations is possible in a as well.

In a sense, one could argue that many types of games are the modern version of tourism or at least a new category. However, most facilitate some sort of tourism as a byproduct and are rarely given full attention. Furthermore, they often include as some sort of action and violence as the main point of gameplay or lack graphic fidelity to represent real life, which does not appeal to everyone. Then, considering trends in today's games, it seems to be a promising potential in advancing development of 3DVT.

To realize the ideas for 3DVT a fair bit of challenges must be overcome. The prerequisite needs to be in place, such as state-of-the-art technologies and a team with a wide range of skills needs to be assembled. Not to mention raising awareness of the product through clever marketing. For the case of creating entrepreneurship this is good news, however not necessarily for case of quick ROI, unless all cards are played correctly that is.

LIST OF FIGURES

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REFERENCES

1. **Trøndelag Fylkeskommune.** *Samfunnsmessig konsekvensanalyse.* Trondheim : s.n., 2018.

2. **EU.** *SMILES.* s.l. : EU, 2020. SEP-210655324.

3. **Stainton, Hayley.** *Virtual tourism explained: What, why and where.* s.l. : Tourism Teacher, 2020. Article.

4. **Wikipedias.** 360 photography. [Internett] https://en.wikipedia.org/wiki/360_photography.

5. —. Three-dimensional virtual tourism. [Internett] https://en.wikipedia.org/wiki/Three-dimensional_virtual_tourism.

6. **Rome Reborn.** ABOUT US. [Internett] https://www.romereborn.org/content/aboutcontact.

7. **Caves RD.** Front page. *Cavesrd.itch.* [Internett] Caves RD. https://cavesrd.itch.io/.

8. **Wikipedia.** Video game industry. [Internett] https://en.wikipedia.org/wiki/Video_game_industry.

9. —. List of best-selling video games. [Internett] https://en.wikipedia.org/wiki/List_of_best-selling_video_games.

10. —. Grand Theft Auto V. [Internett] https://en.wikipedia.org/wiki/Grand_Theft_Auto_V.

11. **Unity.** Real-time rendering in 3D. [Internett] Unity, 2020. https://unity3d.com/real-time-rendering-3d.

12. **Epic Games.** A first look at Unreal Engine 5. *unrealengine.com.* [Internett] 2020. https://www.unrealengine.com/en-US/blog/a-first-look-at-unreal-engine-5.

13. **Ole Martin Ringlund, Even Lusæter.** Kartlegger hele Norge på nytt. *NRK.* [Internett] https://www.nrk.no/innlandet/kartlegger-hele-norge-pa-nytt-1.14896847.

14. **Wikipedia.** Open world. [Internett] https://en.wikipedia.org/wiki/Open_world.

15. **Sony.** Playstation. *Marvel's Spider-Man.* [Internett] 2020. https://www.playstation.com/games/marvels-spider-man-ps4/.

16. **Ubisoft.** *ASSASSIN'S CREED PHOTO MODE.* [Internett] 2020. https://assassinscreed.ubisoft.com/game/en-us/photo-mode.

17. **Sony.** Playstation Store. *Journey™.* [Internett] https://store.playstation.com/no-no/product/EP9000-CUSA00470_00-JOURNEYPS4061115.

18. **Crytek.** The Climb Game. *Homepage.* [Internett] 2020. https://www.theclimbgame.com/.

19. **Wikipedia.** Graphics pipeline. [Online] https://en.wikipedia.org/wiki/Graphics_pipeline.

20. —. AAA (video game industry). [Internett] https://en.wikipedia.org/wiki/AAA_(video_game_industry).

21. **The Hunter.** *Media.* [Internett] http://callofthewild.thehunter.com/#media.

22. **Newzoo.** Key Numbers. [Internett] https://newzoo.com/key-numbers/.

23. **Wikipedia.** Virtual reality. [Internett] Virtual reality.

24. —. **Augmented reality.** [Internett] https://en.wikipedia.org/wiki/Augmented_reality.

25. —. **Mixed reality.** [Internett] https://en.wikipedia.org/wiki/Mixed_reality.

26. **Capt_Galahad.** Cowboah Lasso Shot. *Reddit.* [Internett] https://www.reddit.com/r/reddeadredemption/comments/ht1cc6/cowboah_lasso_shot/?utm_content=title&utm_medium=post_embed&utm_name=87a730935a32479f9bee33f175b6c706&utm_source=embedly&utm_term=ht1cc6.