TAMPEREEN
AMMATTIKORKEAKOULU

SERVICE STREET VR EXPERIENCE

Project report

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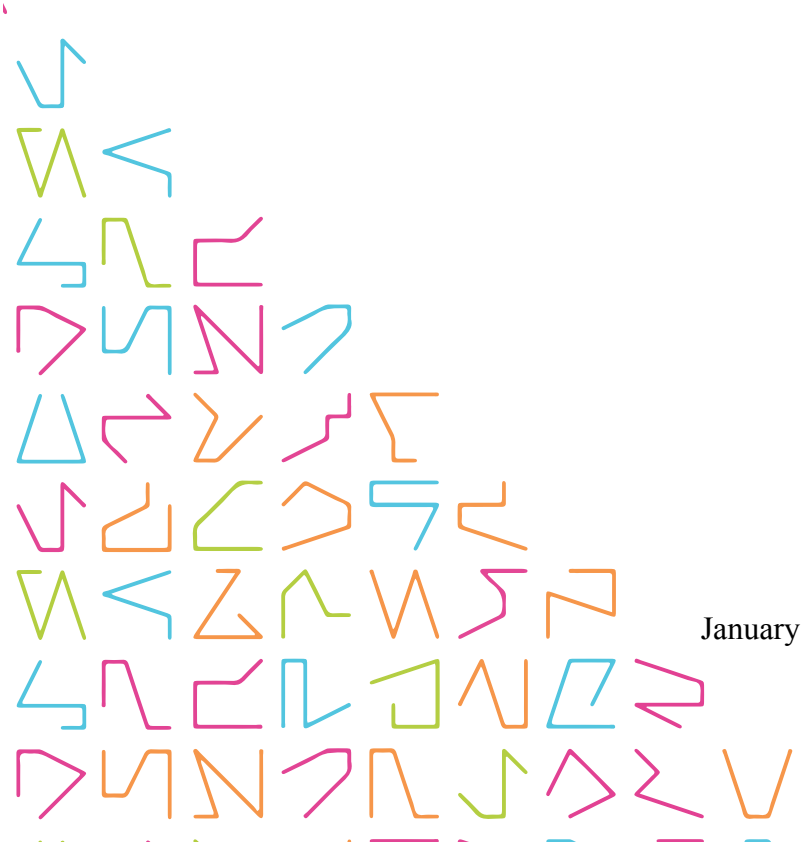

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1 INTRODUCTION

The aim of the project was to create a virtual reality (later VR) experience for a specific part of TAMK's facilities emphasizing the security and safety aspects of that particular space. There were four teams all together, each working on different space. The facilities covered were all located in the Kuntokatu main campus: Open Lab in F-building, festival hall in D-building, Service Street and Y-campus. Our group was assigned to create the VR experience for the Service Street in main campus which runs through the building all the way from the main entrance to the Kuntokatu entrance. The client highlighted that the safety issues were extremely important in this space since it's one of the busiest passages in the building and it includes multiple emergency exits as well as many staircases.

The four teams included students from different faculties including Media and Arts, Business Information Systems, Mechanical Engineering and ICT Engineering. Each group had students from different faculties and the aim was to take advantage of the diversity in backgrounds and expertise. Our group consisted of students from the faculties of Media and Arts, Business Information Systems and ICT Engineering. Only one person in this group had worked with VR before.

The requirements for the project were vague in the beginning mostly because this was the first pilot for a project like this. The teams were asked to explore the space and find the best way to highlight the key characteristics and the best ways to emphasize the safety and security aspects. Our team wanted to take the perspective of a person who is visiting this particular space for the first time and started working from there. From the team's point of view being able to see and "walk" through a space before even entering the facilities would be a great advantage, since Service Street has so much more to offer than most people think.

The tools used in this project included a Matterport 3D camera and the connected Cloud system, Unity game development platform and Blender which is a 3D graphics software.

2 METHODS

To be able to do the project, the team first thought of the experience that they wanted to provide with the product, took the scans of the location and later edited the 3D mesh for more accurate results before putting it in a game engine to create the virtual reality environment and add the interactive elements.

2.1 Initial ideas for the space

Each team was intended to create a virtual reality experience that best suited the characteristics of each space at the same time provide information about the security in campus. Since we were covering Service Street, we wanted to highlight all of the services and information the students can find in that location, as well as providing a way for them to interact with the space.

Some of the ways we thought of providing this information was by dividing the Service Street in colorful sections, since the street itself is divided into sections depending on the services they offer. Also, we thought of including pop ups with information that would appear when the player gets closer.

We were also aware that a lot of students don't fully know all the services that are offered in Service Street or might not have been in the location yet (new students or international students), so we thought of highlighting elevators, printers (and maybe add a link to the user manual or tutorial on how to use it), the toilet locations, the returning "postbox" in front of the library, etc., as well as creating an informational notification board with videos, links to TAMK's website, recent news from the campus, and so on, to keep the students updated. However, we dropped all these ideas and decided to keep only the pop up info and emergency exit simulation for this first version. We thought that given the timeline, it would be better to approach and execute these other ideas in the future.

Concerning the security issues, we thought of highlighting fire hoses, extinguishers, exit signs, etc., as well as adding the possibility to see the Service Street map with the escape routes location marked. Nevertheless, these ideas were also put aside for this initial version of the product, and are left as a possibility in the future. In our initial ideas, we also proposed adding a fire extinguishing game and an evacuation simulation game, but to not

overlap our work with the work done by other groups, we decided to keep only the evacuation simulation, for which we had to include the escape routes in our project.

2.2 Scanning the space with Matterport camera

The scans of the location where taken with the Matterport camera, provided by TAMK. Since we had little knowledge on how to use the camera and what problems it might occasionate in the 3D mesh, we first took some test scans in one part of the Service Street. Since we had to scan a pretty big location, the main doubts we had with it were that if it would recognise its location in relation to the previous scans, if we split the scanning into different days; how accurate it's placing on the area would be and if height variations of the camera (caused by variations on the tripod between different days of the scans) mattered for the quality of the scans.

The quality of the test scans we took on the first days seemed good and came together fine, so we decided to use those as well for the project and just take retakes of those places that were near the escape routes, since we needed to keep doors opened for the player to be able to go through them.

Taking the scans of the whole location and the escape routes was a long task, which was made harder by the fact that we had to take the scans when the campus was open to students. The Service Street is quite crowded location due to it's large amount of services and due to the fact that it's the corridor that leads to the library and the main lobby. This meant that we constantly had to wait for the space to get empty, something that sometimes took a long time or wasn't fully possible. Since we were trying to avoid the most crowded times in campus to take the scans, we were taking them during evenings when it was dark outside, which gave us dark and unpresentable scans since the player would not be able to see the surroudings outside.

The task was also made harder by the fact that the staff were moving some furniture away from the offices, and have left it in the corridor in between the days of our scans. Ideally, all the furniture and extra elements (banners, bins etc.) should have been removed for a more accurate 3D mesh. Instead, we were confronting the opposite situation. Since the additional furniture that had been placed in the corridor wasn't going to be moved from there until holidays, we had to include it in the scans as well, but the parts of the corridor

where this furniture was placed should be scanned again in the future so that there are no extra elements in the final virtual reality experience. Also, the campus shop moved from the end of the corridor to the main lobby in between scans, so we didn't incorporate its new location in this first version of the project and this of course, should be corrected in a further stage.

Also, we found that when taking the scans, sometimes the camera would stop mid scan with a "not connected to a camera" text in the screen, or just stop working and not showing any error or any reason why, which also slowed down the workflow since we had to reset the camera to continue working.

As a result of all this and, especially since the location we were scanning was quite large, the scanning took more hours and days than was initially expected. In the end, the team took more than 275 scans to cover all of the space (we later found out that no more than 100 scans per scan is the ideal for higher quality results, but it was too late since all the scans had already been taken).

2.3 Working with the 3D mesh in Blender

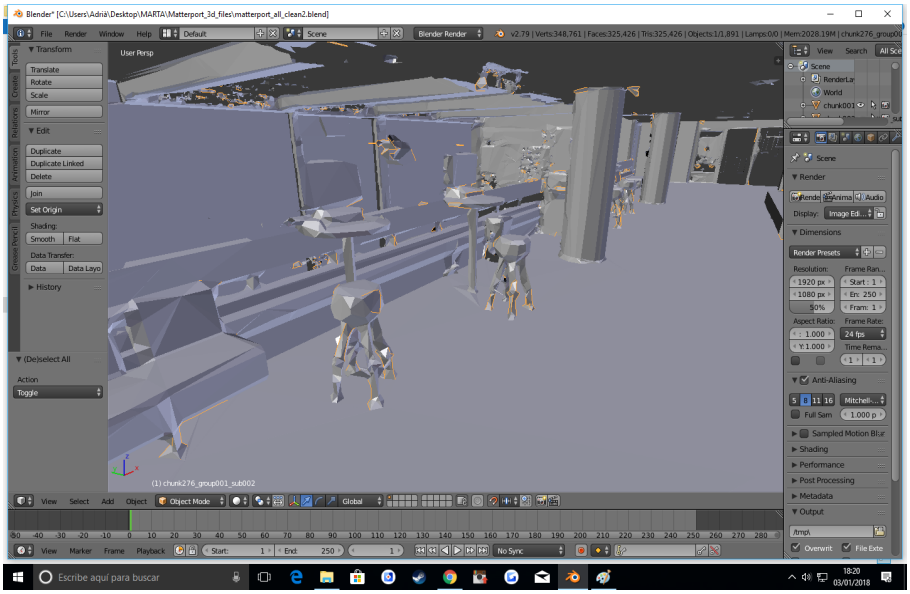
The Matterport camera creates a file with the 3D mesh (.obj file) and materials (.mtl file) to be downloaded from the Matterport website, so that the file can later be edited with 3D software for more precise results. In this case, the team worked with Blender. Initially the workflow and the problems this part of the project would present were unknown, due to the inexperience of the team working with the camera.

The first step was figuring out how to work with the mesh in Blender. One of the main problems was that, since the team was working with a very big space (Service Street and its evacuation routes), the files contained a lot of information. This made the file difficult for the computer to process, which consequently resulted into either having to work the space by pieces into different files and then having to put them back together or hiding the parts that are not being used.

The 3D mesh created by the camera is not very accurate, so it needs a lot of retouching. However, the Matterport camera turns out great for capturing the texture and the lighting.

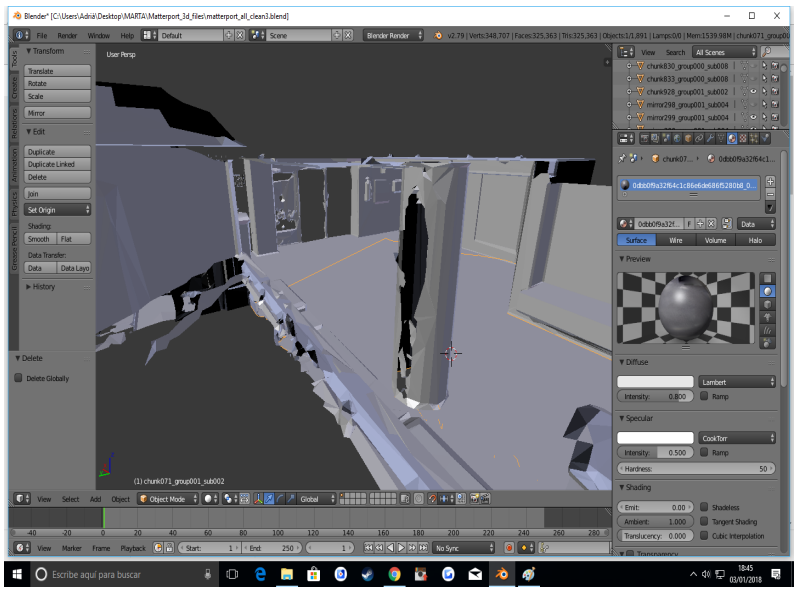
Maybe a good idea to consider in the future would be to model the 3D space manually and then project the texture on it.

The way in which the camera arranges the 3D geometry in the file is by dividing the mesh into “chunks” (as called inside the very same file). However, since the camera doesn’t recognise what is part of the same object in the space, so one object is formed with different “chunks” that at the same time are randomly grouped with other “chunks” in different locations and from different objects. This can be seen below in picture 1. Here the “chunks” highlited in orange are linked to one another. This fact makes it harder to work with each part of the mesh, since when selecting a part of the mesh the file selects other “chunks” in other locations. The “chunks” should be regrouped for proper working, but this would be an excessive, time consuming task not worth doing, especially with such a large environment since the large amount of small “chunks” are spread in the 3D space.



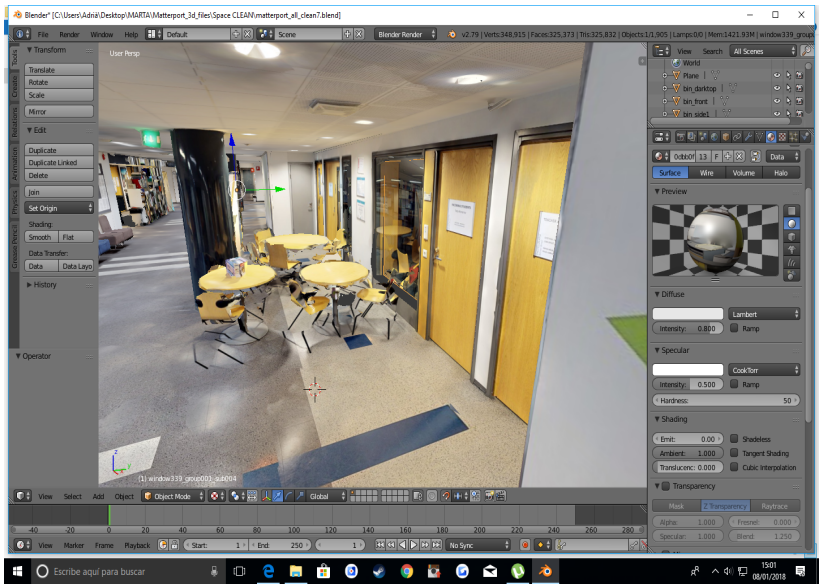
PICTURE 1. The spreading of ”chunks” in the 3D space.

Obviously, the 3D mesh gets problematic when the camera hasn’t scanned behind an object, so as a result it invents the 3D geometry in that area. This could be fixed taking some scans behind these objects, but in some cases it is not possible to place the Matterport camera behind certain objects due to small space, so the mesh becomes unprecise or incomplete and should be fixed for a more realistic outcome (see picture 2).

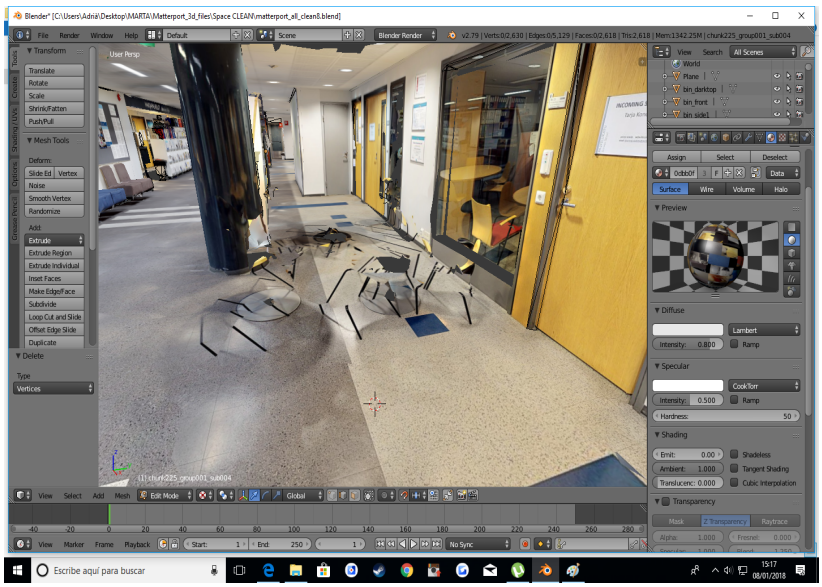


PICTURE 2. Problem with a pilar, when the back of it is not scanned.

The .mtl file associates different materials to each “chunk”. However, in the same way that the camera might create “chunks” that might be wrong, it might mistakenly place a material in the wrong “chunk”. If this “chunk” has to be removed due to the fact that its geometry is wrong or badly placed, the material supposed to go with that piece might be in associated to another “chunk”, making it still oddly looking when the piece of geometry is removed (pictures 3 and 4).

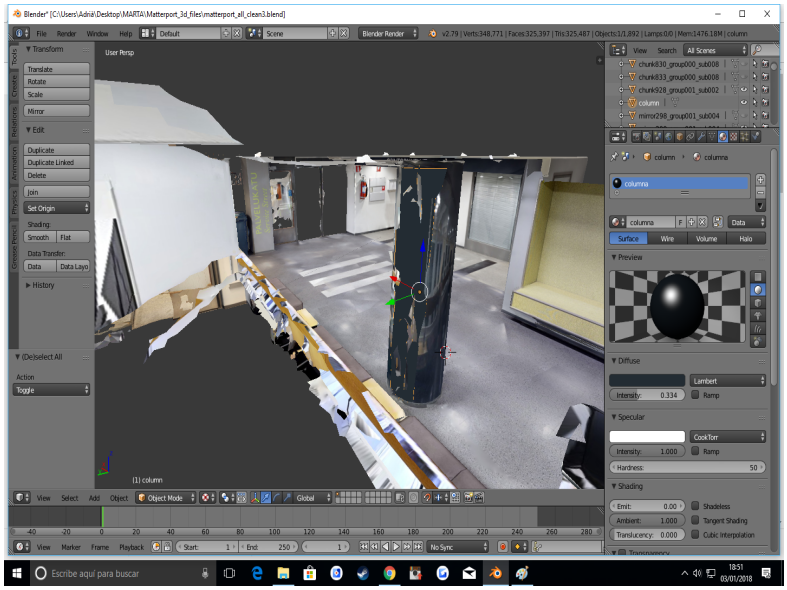


PICTURE 3. Texture issues in Blender 1.



PICTURE 4. Texture issues in Blender 2.

It also could happen that removing a “chunk” in the 3D mesh, the material for another part might get lost as well, making it necessary to be manually recreated to try match the camera’s material, in which case it’s very difficult to do. The same happens when there’s a gap in the mesh that needs patching, the material has to be replicated manually and it is very difficult to make it look the same as the material created by the Matterport camera (picture 5).

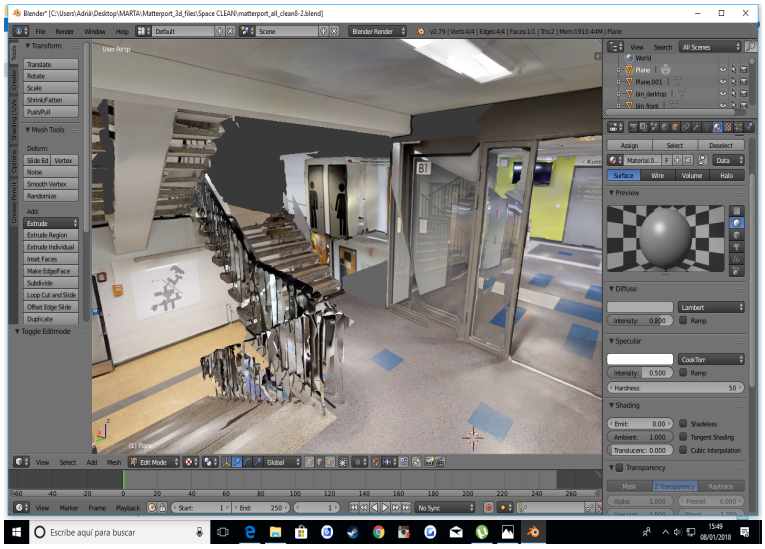


PICTURE 5. Trying to fix issues with materials in Blender.

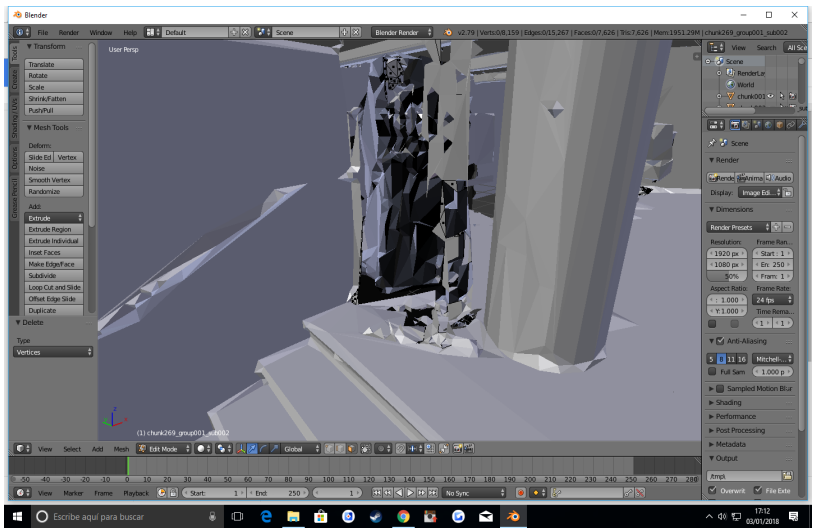
When working with the file in Blender, it initially doesn’t show the materials since it displays the mesh in solid view mode as default. To be able to see the materials, the

viewing mode has to be changed to textures. This helps to interpret what is every part of the mesh supposed to be since, as it was mentioned before, its geometry might not be very accurate and the resulting shapes might not be very precise. Working with the texture view though slows down the workflow a lot, since the computer has to process a lot of data. Consequently, this results in a constant switch from solid to texture view in Blender to be able to work with the file.

Overall, some of the parts where the mesh was messier in the project where columns (the back part where the camera couldn't scan), the stair railings (picture 6), promotional banners (picture 7) and some pieces of furniture, in which cases the decision had to be done between removing the geometry, retouching it or leaving it as it was depending on every case.



PICTURE 6. Issues with 3D mesh in stairs.



PICTURE 7. Issues woth 3D mesh in columns.

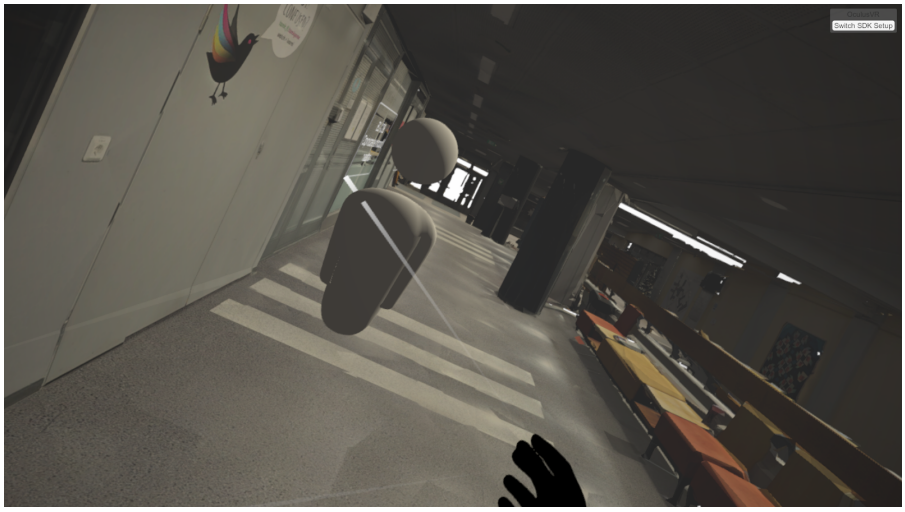
In the future, it might be interesting when correcting the 3D files created by the Matterport camera to investigate if an entire object (e.g. a seat) could be erased from the original file, modelled from scratch and then have its materials projected only to that object. However, keeping in mind that not all the materials are associated with the right “chunk” of mesh, it seems an improbable possibility.

2.4 Working in Unity

To create the whole interactive experience, some elements have to be added with a game engine such as Unity. In order to be able to work with the file, SteamVR, Oculus Rift and VRTK (Virtual Reality Toolkit) plugins were downloaded to Unity from the asset store. Using the VRTK makes development faster and it's supported by both PC-virtual reality devices and GearVR making it ideal for future versions. Later, the 3D model of the space was added, and the VRTK player prefab to the scene.

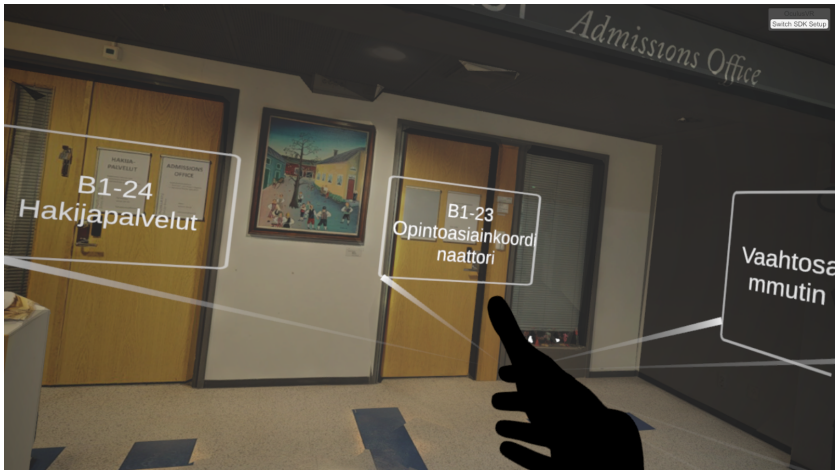
Teleportation was enabled to the player to make the user able to move within the scenes with the pointer. In order for the player to select where to teleport, colliders were added to the floors of the scenes. However, the meshes generated by the Matterport camera are often messy, meaning the VRTK's mesh teleport can’t be used with mesh colliders. This results into having to manually create floor colliders used to enable teleportation.

Since part of the interactive experience is an “evacuation simulation” where the escape routes are shown, a game object was created which follows the player and spawns a moving avatar towards the nearest emergency exit with a click of a button as seen in picture 8. These avatars are controlled by a NavMesh to navigate through the space. NavMesh proved to be surprising compatible with the Matterport models.



PICTURE 8. Avatar moving towards an exit.

To provide information about the different services offered in Service Street, different items were given game objects which contain information about said item (door for study counselor, fire extinguisher etc.) as seen in picture 9. Finally, these places and objects of interest needed highlighting in some way. To do so, a line render was added to these objects so that when player gets close enough, a line runs from the player’s hand to the item pointed. This highlights the wanted information and draws attention to the item.



PICTURE 9. Informational tags and pop ups.

It was found that it is important to use neutral lighting settings and that it was also probably smart to leave shadows out since the models are essentially shaded already in real life. Placing lights manually would be extra work for little to no gain. However, this creates slight uncanny valley, but is unavoidable at this point.

3 RESULTS

In the beginning the objective was to create the minimum viable product for the initial idea and not concentrate too much on details and our team feels like we accomplished that. On our final version, the player can navigate through the scenes and explore the Service Street area. All the main emergency exits and other entrances are accessible and information about the services and security and safety issues are highlighted. To make it more interactive player can in any point of the space see which are the exit routes and how to get there by following an animated figure which appears with a click of a button. Items can also be pointed at close range and when pointed information about that item is shown.

Eventhough we feel like it's a good 1st version of a usable product, it still requires a lot of work before it can be used as a presentable and interactive guide for outside visitors and e.g. exchange students. There are still quite a few problems with the 3D mesh and textures and since the scan was done as a one big scan the file is very large. Because the Service Street is a large space itself, the scan should be taken in parts and the pieces should be connected later in the process. This would improve the quality and make it easier to work on. Also, as mentioned earlier the scanning of the space took much longer than initially expected, so we didn't have as much time to work with the 3D mesh in Blender as we would have liked. We thought this would have improve the quality of the product significantly.

Due to the lack of time towards the end of the project our team had to put aside multiple ideas that we were hoping to execute. Mainly the division of the hallway into colorful sections, a pop up map showing your location in the building or in the Service Street and more interactive notification boards would have been great additions to the VR experience.

Since the feedback from the first stage pitches and demos was encouraging, we felt that we picked the right things to concentrate on and came up with a lot of useful information for the future projects of this kind.

4 DISCUSSION

Even though we didn't really get as far with the project as we would have liked to, the whole team feels like we have learned valuable skills and given a good base for projects like this to be carried out in the future. Most of the project was about exploring the tools given and the options and possibilities of the space.

For all of us the Matterport camera was a completely new tool and hence using it required a lot of testing and retesting. We learned great deal about which is the best way to use it when using it for a VR experience and working with it will definitely be easier later on with the knowledge acquired. Blender was a quite new tool for the whole group and working with the 3D mesh proved to be even more laborious than expected. Since Aleksi was already familiar with Unity in the beginning, he was mainly responsible of the work done with the game engine.

For most part of the project the team worked either in pairs or all three together. Scanning the space with the camera was easier with multiple people there, since there was stairs and tricky angles to cover, doors to be held open and some furniture which had to be moved during the scan. The team dynamics worked well for us and we had a clear idea of the division of work already from the beginning. Aleksi concentrated on working with Unity, while Marta and Pauliina took care of the scans and worked with Blender. In the beginning however, we saw it fit to familiarize ourselves with all of the tools, so that each of us had some idea of others workload.