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Pilot project report

BrannVRn



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Abstract

BrannVRn is created by Bachelor students from Gameschool INN Hamar and commissioned by Sykehuspartner HF (SP) from Drammen, Norway. SP delivers services within Information and communication (ICT), projects, logistics and Human Resources (HR) to all hospitals in Helse Sør-Øst (HSØ) in Norway (Sykehuspartner, 2022). SP requested a Virtual Reality (VR) training aid that can gamify, compliment and later replace existing fire safety training for employees. BrannVRn is an attempt to tackle the gamification of existing fire safety protocol in virtual reality, based on SP requests. Current SP fire safety training protocol is an online course based on HSØ regional firecourse adapted to SP office. Subsequently, BrannVRn was instructed to be based on this online course. A Meta analysis done by Wu “*showed that Immersive virtual reality(IVR) using Head Mounted Displays (HMD) is more effective than non-immersive learning approaches with a small effect size.*” (Wu, Yu, & Gu, 2020). Hence why VR is more preferred over conventional 2D and 3D approaches. BrannVRn is a Virtual Reality Fire training simulator. Where gameplay will be simulated in SP offices in Drammen. Making the course more educational, accurate and hopefully more engaging.

SP requested that the office and all fire equipment and marking is located at a corresponding position in the simulator as in real life. Hence why the office layout must be replicated as close to reality as possible. The simulator will take place on the second floor of SP’s office. All fire safety equipment will be interactable and functioning as it would in real life to ensure

that staff members gain extensive knowledge on how to operate them in case of a fire at their office space. SP's current fire safety course teaches the staff about fire prevention, protocols in case of fire and how to theoretically use the equipment on site.

1. Customer request

1.1 Training protocol

Handling ved brann

I denne delen av kurset får du en teoretisk innføring i de tre viktigste handlingsprinsippene ved brann



Varsle - 110



Redde



Evakuerer

Gå videre i kurset for å lære mer om disse handlingsprinsippene.

Fig.1. Front side of SP's training program

SP's training program consists of 15 slides and three quizzes, this is the foundation of the simulator.

“Handlingprinsipper” roughly translates to principles of action, these include; Assessment of the situation, warn the fire department and others, save and lastly evacuate. According to Hamari “*Gamification is the strategic attempt to enhance systems, services, organizations, and activities in order to create similar experiences to those experienced when playing games in order to motivate and engage users.*” (Hamari, 2019). Thus BrannVRn intend to gamify these protocols by implementing “scenarios” where each principle plays out. More on this later, firstly some restrictions need to be addressed.

1.2 Employee demographic

First restriction is players. Main Demographic is SP employees, ages ranging from 25 to 67 years of age. 67 being the age of retirement. Most employees according to SP have not engaged in VR games, and have little to no experience. SP added that BrannVRn should be designed to accommodate first time users, as most employees according to SP have little to no experience in VR, this is also reflected in our game testing sessions with SP.

Our first concern is motion sickness. In the study of Freitag et al. (2016) “users who have no prior experience in VR reported greater discomfort showing higher SSQ scores and poorer task performance in VR.” (Freitag et al., 2016) and study done by Chang (2020) showed that “*symptoms were oftentimes speculated to originate from poor performance of the hardware*” (Chang et al., 2020).

So to alleviate motion sickness, it was decided to stick to only teleportation locomotion as “*study showed that this locomotion was the best technique with less motion sickness.*” according to Khundam (Khundam, 2021).

It was also paramount that we keep frame rates at or above Headset frame limit to limit hardware induced motion sickness. More on optimization later on.

1.3 Testing with SP Employees

SP had biweekly meetings at their offices for testing and development. Early game testing proved to be invaluable, as it illuminated lots of shortcomings of the inexperienced players when it comes to VR. It was therefore requested a tutorial on how to use fire equipment, as many testers had not used fire equipment before. The tutorial map changed throughout the project, depending on the demographic it was tested on. While the game school students of INN Hamar quickly picked up on the controls and knew how to use VR proficiently, the inexperienced staff at SP struggled and had to be guided throughout all of the steps.

Most noticeably, SP staff had issues with using locomotive snap rotation and general movements in game, and in some cases did not realize that one could move their head physically in VR. Testers also had issues grabbing onto objects. And general unease when

met with a stressful situation, so it was pointed out that they needed training first. Hence a tutorial on how to use fire equipment was necessary.

1.4 Tutorial layout

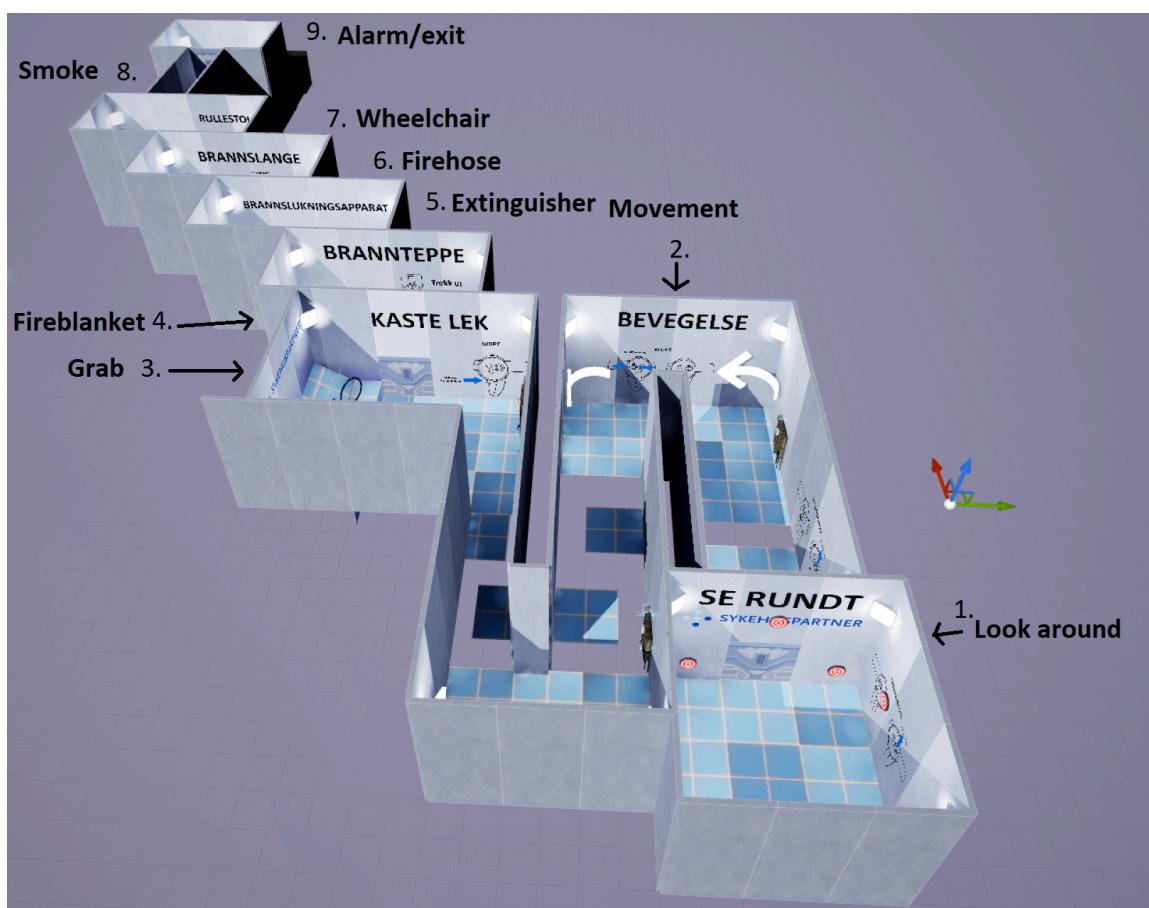


Fig.2. Tutorial map layout

The layout of the tutorial map helps guide the player so they get accustomed to VR and its controls, consisting of nine sections, each tackling a specific problem, as seen in [Fig.2]. We have attempted to fill as much space with infographics [Fig.3] to help remind the player of the controls. Full overview of infographics can be found in the appendix.

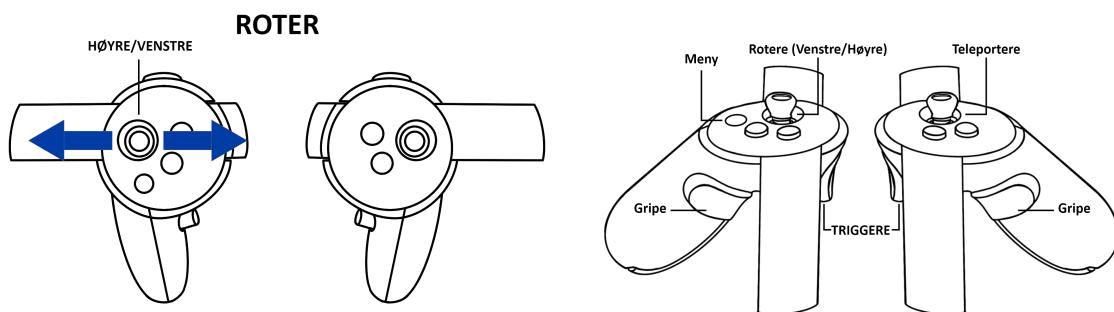


Fig.3 Controller instructions and rotation

“Developing better first learning levels can be a key step to ease the casual gamer into play...” (Desurvire & Wiberg, 2010). First section is “Look around”. This section tackles the movement of the HMD, in order to proceed, one has to look at 5 “targets” in order to open the door and proceed to the next section. Following is “movement”, simply removing platforms forces players to use the teleport. Corridors also have 180 degree turns, combined with section specific controller infographics [Fig3]. Testing and feedback shows that it gives a clear guide how to use our movement schema. Last important section is related to grab, here one must throw cubes through rings to unlock the door and progress. This section introduces grabbing and throwing, giving players some time to play to keep up engagement, and at the same time learning eye hand coordination in VR. The rest of the tutorial map covers steps on how to use each equipment. To proceed, the player must extinguish and rescue, depending on the section. There is also a hallway filled with smoke to introduce the player to the dangers of smoke. To reiterate, BrannVRn is a simulator and not a conventional video game, nevertheless, play is an important part of engagement and learning.

2. Realism

2.1 Talk with the fire department

For the project it was important to get information and input from professionals in order to be grounded in reality. Therefore communication was established with the local fire department in Hamar, specifically fire engineer Johan Snartum, who works at Hedemarken Brannvesen. He specializes in fire prevention and safety. Snartum tested the simulator and gave his feedback. From the meeting, there were highlighted important focal points. Snartum pointed specifically to the importance of smoke functions, the displaying of fire safety information and most importantly the conveyal of stress. As he pointed out that fires are a particularly stressful situation, something BrannVRn should emphasize through sound and particle design. It was important for the simulation to add elements that anchors the simulation in reality. This includes alarms, visual indicators, and audio from the fires themselves.

2.2 Smoke danger

BrannVRn should ideally include a system that tells you how long you have been in the smoke, as Snartum brought this up as a particular concern. He pointed out that people might not be aware of how much time people spend in smokes during an emergency. This is also backed up by an article interviewing fire chief Geir Preus of the Fire and Rescue Service in Oslo (Tidens Krav, 2011). Preus said that getting through thick smoke is dangerous. The smoke can get extremely hot and cause burns to your throat and lungs. It contains so many toxins that two inhalations are enough to stop you standing up. Matching what Snartum pointed out also.

Furthermore, NHI states that in most cases people die of the smoke before the fire gets to them. NHI states that Death by fire is one of the most common causes of death in the home. Most deaths are caused by smoke inhalation, of which up to 80 per cent are caused by carbon monoxide poisoning. (NHI, 2020)

A solution to this was to add a “Vignette” effect, overlaying the player's visual field. This is to visually notify the player, and also constrict player vision, adding further stress. The Vignette is also coupled with coughing sounds cues to further notify the player and apply more stress to the player. Prenderville writes that “*Short-term acute stress constitutes an*

adaptive response and is an important feature of an organism's ability to respond to stimuli in its external environment and thus plays a crucial role in maintaining one of the main characteristics of life" (Prenderville et al., 2015). It is desired to expose the player to similar stressors as one would experience in a potential fire situation. The simulator, in the future, should end the player's scenario, if they "inhale" too much smoke, effectively simulating a deadly dose. As it stands, smoke feedback in BrannVRn does not convey the severity, according to this research, due to time limitations.

3. Art style and asset creation

The aim for the art style is to replicate and keep as close to the office content as possible, as the fire safety training has to be as close to reality as possible in order to reflect SP fire safety protocols. The art style of existing fire equipment logos, textures, posters and maps for this type of VR simulation gives little room for creative freedom.

3.1 Tutorial/lobby:

The tutorial and the lobby art style direction builds on the wishes and suggestions from SP. The original idea for the tutorial map was given to us from SP in a brief for this project. SP came up with a suggestion for the tutorial map, that goes as follows "We plan to select about 10 courses, and have thought that the presentation can be done as a journey in the world. Each course is its own planet, and the user should be able to travel between these planets in a spaceship. This is just a suggestion from our side. We would like students to come up with their own creative ideas and implementation suggestions, preferably something completely different."

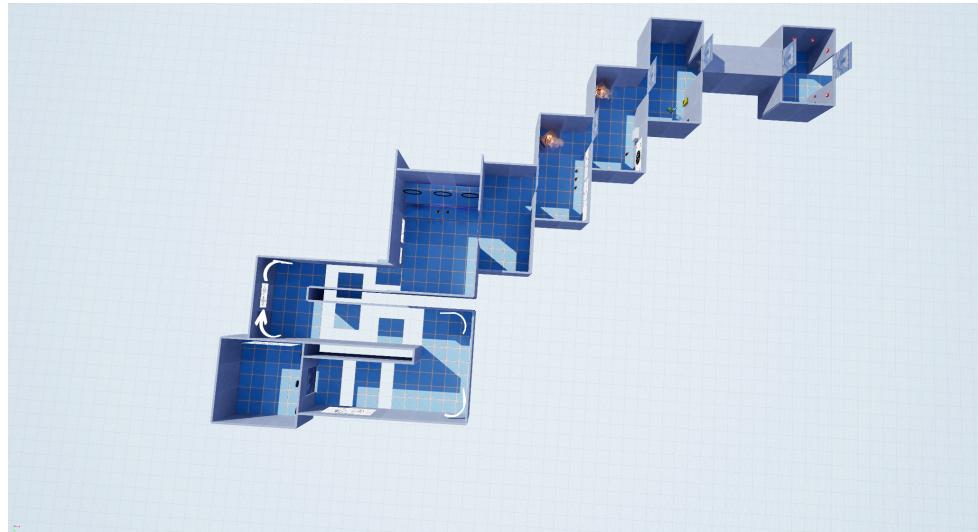


Fig.4. Tutorial map birds eye view

It made room for creative freedom by SP in this section of the game. It was decided to meet them halfway on their suggestion and go for a simplified futuristic/sci-fi style. The part with traveling to different planets was cut out because it would otherwise take away valuable time for the actual gameplay and for the simulation.. They are set in a scene where one can see the stars and the moon to simulate a space atmosphere. Futuristic floors and doors are added to emphasize the futuristic/sci-fi look. Also added electrical boxes with added electrical short circuits.



Fig.5. Lobby map birds eye view

3.2 Colour palette

Sykehuspartner requested we use certain established colour codes, based on their logo (dark blue #003A8C and light blue #07B2DC **Fig.6**). It has been used on things like, for example, the menu (UI/UX) inside the game. The SP logo has been added as well into the tutorial and to the scenario maps. Taken from SPs internal manual "The dark blue colour satisfies the requirement for contrast ratio against white for plain text. The light blue colour does not" (file:///C:/Users/herma/AppData/Local/Packages/microsoft.windowscommunicationsapps_8wekyb3d8bbwe/LocalState/Files/S0/6/Attachments/Sykehuspartner%20-%20Intern%20h%C3%A5ndbok[604].pdf) Otherwise it has been given freedom to use whatever other colors in the simulation.

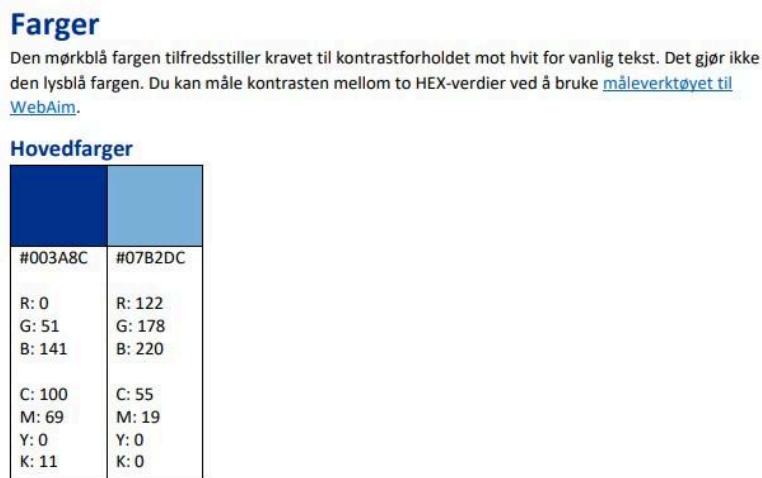


Fig.6. color pallet from SPs internal manual

3.3 UI/UX

A simple and good, but also clear menu that would be easy to access and not be in the way for the users was important. The use of UI/UX is restricted to the menu set up inside the game. The placement of the in game menu was determined by the difficulty of having a normal menu setup which is normal in most games, because it is in VR and it would need to be created as a 360 rendition of the menu setup. Therefore it was easier to set it up as an

in-game object for the users to easily have a good visual over the menu. The menu has followed the colour codes issued by SP (dark blue #003A8C and light blue #07B2DC). The buttons have three different colours for when you hover over, not hover over and when you press the button. This is to make it easier for users to decipher where they are and what they press. For now all the functions on the main menu do the action that the buttons say they do. would be added more functions on the options menu at a later time.

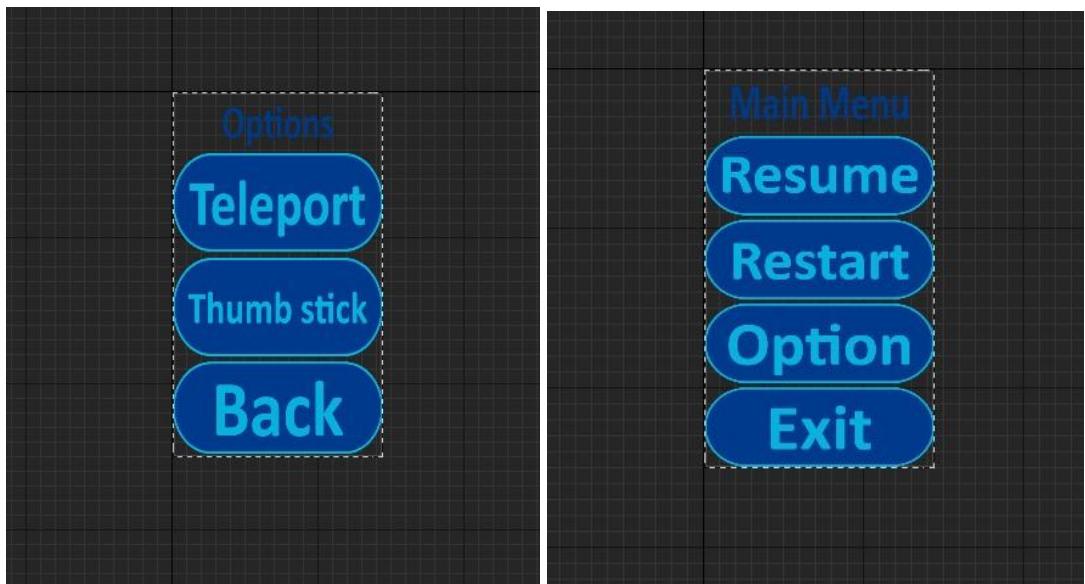


Fig.7. Menu UI/UX

3.4 Typografi

Taken from SPs internal manual “Typography We use the font Calibri in our products. This is anchored in the national profile program for health agencies. Calibri comes in variants light, light italic, regular, italic, bold, bold italic. For maximum readability we only use the variants regular and bold”. In the beginning it was made use of another font than Calibri, but got told from SP to change it to Calibri when writing on textures and on infographics in game. It has been made using Calibri bold and regular.

3.5 Infographics

Infographics have been used a lot in the training map and in the first scenario of the fire simulation course. For the training map there was a big focus on giving info on how to use

control and make various movements. It was important to have clear information and description. It was solved by using visual drawings on the wall that explained how to use the controls with text and arrows. This is for those who are both new to VR and for those new to the simulation. It was desirable to be able to give as clear a demonstration as possible and to familiarize the users with the controller setup. A description of all the buttons and all their assigned uses was added (**Fig.3 s.7**). It where added infographics for more specific actions, such as teleport and rotation among others (**Fig.3 s.7** and **Fig.8 s.13**).

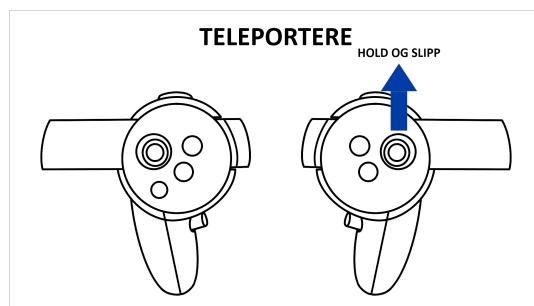


Fig.8. infographic of how to teleport

The info box has been used as infographics for the first scenario. The infoboxes act as an extra source of information. The info boxes are based on the course from SP on which the simulation is based. Their function is for the users to become and familiarize themselves with all of the important information pertaining to fire safety. They also provide more detailed and explanatory information on various equipment. How it should be used and for what it can be used. It is also used to explain the reasons why things or objects may be problematic. The info boxes are gray and transparent on the background. The text is white and has black lines to make them visually easier to see. . Especially when the office building walls are white. To avoid the text and the walls merging, the info boxes are gray and transparent on the background.

The evacuation maps function in the game is to be a guide for the office map in the fire safety simulation (**Fig.9**). There have been some deviations from the rules when it comes to the evacuation plan. According to the rules that says:

“The evacuation plan must give a representation of the following conditions, ref. NS 3925:

- Identification of escape and evacuation routes
- Fire instructions and procedures
- Location of fire-fighting equipment and alarms
- Location of emergency equipment and evacuation aids
- Location of rescue sites and meeting places”

(*SpesialistBedriften, n.d.*)

Information on fire instructions and procedures has been omitted. The basis for this is that it is covered by the fire simulation itself. In the course it will be informed about this through info boxes and in SP's own course. The location of the meeting place and the rescue site is also taken away from the evacuation plan. This is instead covered through 360 images and information one finds in SP's fire safety course. The map has also been blown up in size for it to be visible in game. Lins, text and information logos have been enlarged. The logos for the different equipment and alarms are held as similar to the existing ones to keep it recognizable for the users. The wheelchair logo has been added to the map, that is a new addition to the map. The reason is to inform the user where they can find it in the map, because it is essential for the scenario walkthrough.

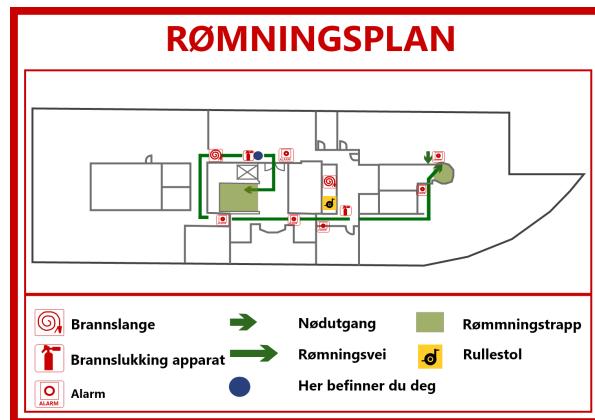


Fig.9. evacuation map

For the textures/adhesive marks for the fire extinguisher, fire hose, wheelchair and fire blanket the design is kept close to their original design (**Fig.10**). It has been used the same colours and kept relatively similar in their design layout as the originals. Reasoning for that is so the user's get used to the equipment and the look in case of need in an emergency. Typography changes have been done, so the text is easier for the reader to read. Calibri was

used as the font type to follow the direction and wishes from SP on the wheelchair and fire carpet texture. Calibri Italic is used on the fire extinguisher texture.

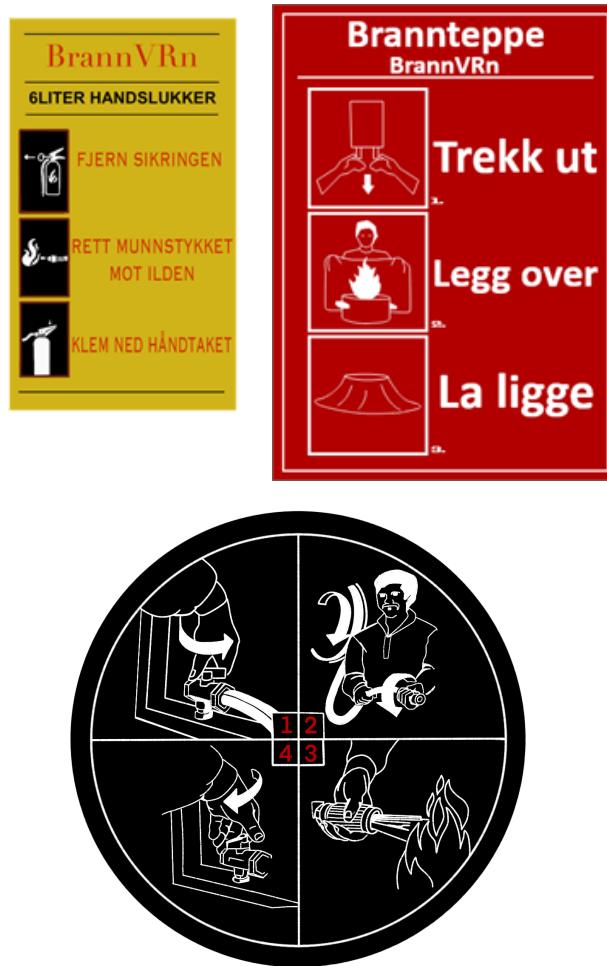


Fig.10. Textures for fire extinguisher, fire blanket and fire hose

Signage and clearance plans have been important for the project to get in place. It has been important for the fire course that these are well visible signs and that they correspond with the signs in the premises. But also in relation to the rules for fire signs and fire safety signs (**Fig.11**). Gathered from Merkefabrikken.no “Fire signs and fire extinguisher signs must be rectangular or square in shape with an illuminated symbol on a red background and the red colour must cover at least 50% of the sign surface” (Merkefabrikken, n.d.)

In the posters, yellow/green color is used on the border of the posters to imitate the luminescent plastic. They also follow that the posters must be square and that the smoke color must cover at least 50% of the posters.



Fig.11. Fire extinguisher and fire hose posters

The evacuation signs do also follow quite similar rules as the fire and fire safety signs (**Fig.12**). Gathered from Merkefabrikken.no “Evacuation signs must have a rectangular or square shape white symbol on a green background and the green color must cover at least 50% of the sign surface” (Merkefabrikken, n.d.) The reason why there is so much focus on keeping the actual emergency and fire equipment signs as close as possible to the originals, is so that users can recognize them as well as possible and so that they can recognize them in an emergency. This is to make their training as complete as possible and to help them understand that these are the signs they need to look for and find in such situations. The aim is for them to be able to orient themselves as automatically and as easily as possible and to find the signs as quickly as possible in a situation where it is necessary.



Fig.12. Evacuation poster

Decals and sprites have been used as visual indicators and as 2D textures for objects. Its been made use of decals to add the effect of amber burning. The decals change brightness from very bright and intense orange light to being no light at all. That is so the users will get a

visual indicator on when the fire is put out. The light effect follows the HP system for the fire. Sprites have been made for things such as the yellow vest that is shown (**Fig.13**). And among other things like, textures for the alarm buttons, infographics, SP logos on the TV and laptops etc.



Fig.13. yellow west sprite

3.6 Office

The main focus of recreating SP's office space was to recreate it as closely to reality as possible so the users would recognize where they were, which would help ease the inexperienced users into using VR as a training aid. Measurements of SP's office space, office equipment and fire safety equipment were gathered early to ensure that we could recreate everything that was required for the simulator. Pictures were taken at SP's office space to ensure that the location of all relevant fire safety equipment, emergency signs and alarms was as exact as possible.

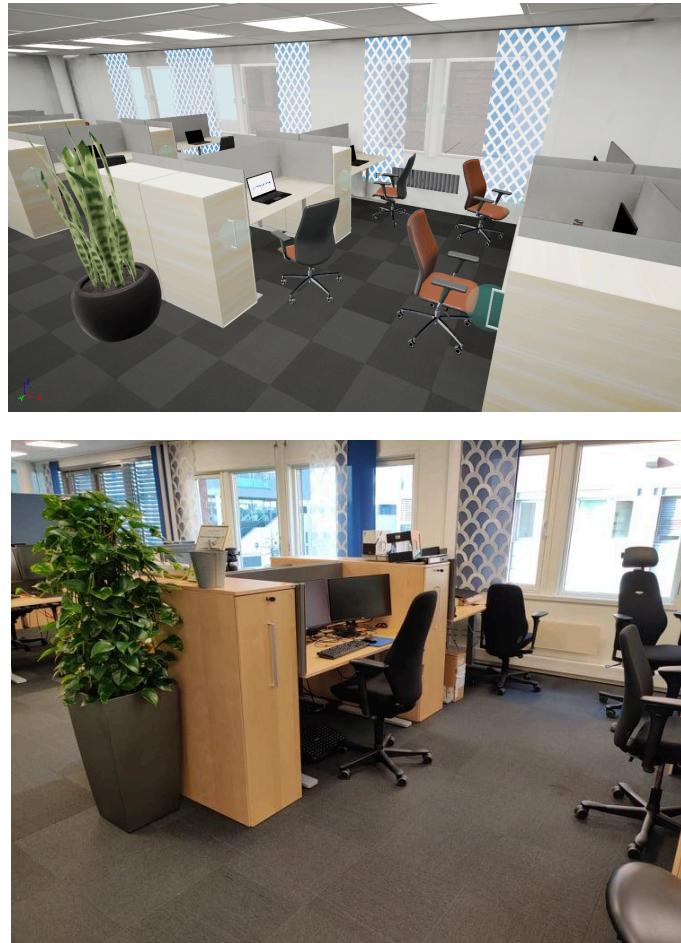


Fig.14. comparison of game and reality

The bi-weekly meetings gave regular feedback that were used to make smaller changes, however most feedback was positive and even with a simple blockout of the office space the employees at SP were able to recognize where they were within VR. This was a reassurance that there was a good understanding of what had to be created and how it had to be created.

Realism has been a big part of getting the level of immersion that is wished for in the simulation. There are places where it's been cut back on realism and there are places that focus heavily on realism. For the reason of keeping true to the office and the fire equipment in it. Making realistic fire equipment with looks and function. It has been important that it visually looks like it actually does in their office space. With the purpose of easily recognisable equipment, and so that they know what to look for in the event of a fire. There has been a large focus on equipment, which is the fire extinguisher, fire hose, fire blanket and evac chair. As well as the office and the building, there has also been a spotlight on keeping it

as realistic as possible. In relation to what you find in the office's desks, PCs, carpets, kitchen, general office furniture. Since the users are the employees at SP, it is important that they get to know their office space and get a good understanding of their surroundings. All the firefighting equipment will be placed on the actual sites that you will find in the offices. The users will actively go to each of the points and not only see but also interact with the fire equipment. The 1:1 scale falls into play when wanting to get a realistic perspective in the simulation. This ties again into the level of immersion that is wished for in the VR simulation. So that people feel that the room and their surroundings are on the same scale as they would be in real life. This goes more on the holistic experience of the surroundings.

For the simulation it was focused on making the interior and various office equipment and furniture look and feel as realistic as possible. According to Hvass "*The results showed that higher geometric realism produced stronger presence and fear responses as assessed by self-report and physiological measures.*" (Hvass et al., 2017). In our case, we look more at presence and immersion, and that it really gives the feeling that players are in their own office space. This is to reinforce the impressions and really make the players familiar with their fire routines in their own offices. Similar projects to our fire safety course have already been done. Where they have found that similar solutions can lead to and give a high level of feeling of being present and immersed.

Due to the limitations of VR, we have attempted to keep the polycount as low as possible for the 3D assets that have been created for the project. While some assets have been imported from Quixel to cut down on production time. The reasoning for keeping the polycount as low as possible is to ensure that the frames per second (FPS) is stable and as high as possible since low FPS can create nausea very easily within VR, which was a concern for us.

As of now there is just one floor of the SP office that has been recreated, alongside some basic exterior assets to populate the scene if the user is to look out the windows. Future expansions could include multiple floors of the office and a finished exterior with a meeting point.

3.7 Music and sound

A focus for sound and sound effects has been to create a sense of urgency and attempt to stress the player as much as possible, since an emergency situation is not supposed to be relaxing. Therefore, we have added an intense sound effect for the fire, so the player is able to identify where the fire is. We have also added a harsh coughing when the player is too close to the smoke to deter them from inhaling the smoke, you can read about the dangers of smoke during a fire above. Regarding the feedback about smoke from Snartum this was one way to tackle the problem in VR.

There are other minor sound effects to signify that the player has completed a task, ie looking at the targets during the tutorial and throwing the cube through the rings in the ring game.

Other sound effects have been added to indicate that a player has missed a step, like not pulling out the security pin out of the fire extinguisher, this was added due to it being hard to identify which step the player forgot about in VR compared to real life.

According to Klimmt music has a positive effect on the users, “the findings consistently show that music, indeed, adds to players’ experience of gaming. These effects are primarily emotional in nature” (Klimmt et al., 2019) Music was added to fill in time where the user had to wait while they were being moved back to the lobby area after completing a scenario. This was done at the request of SP since they mentioned that the user might get bored doing nothing.

Some sound effects that could be added in the future are footsteps, doors opening and closing and ambient noise.

4. Fire simulator assets

4.1 Flame system



Fig.15. Flame on a desk

The primary aim of this VR simulator is to gain a basic understanding of relevant fire equipment, and to do that, extinction dynamics for flames needs to behave properly. Key aspects of extinguishing consists of, aiming the extinguisher at the source of the fire and swiping the flame with the extinguisher in order to prevent reignition.

Firstly, the collider for hit registration is located only on the surface of the object, as aiming the extinguisher at the plasma is not effective. As seen in [FIG OF FLAME] the hit detection collider is very close to the base of the flame. Particles and the audio volume is also scaled with the health point (HP) of the flame, ranging from zero to 100 HP. Zero being extinguished and 100HP being the max size and volume of the flame. Main HP calculations are done by averaging the HP of each of the four sub colliders. Dividing the flame colliders into four sections incentivises players to use swiping motion in order to extinguish the flame. Failing so, reignites the flame, as all sections need to be at 0 HP for the flame to be extinguished. Same dynamics can be observed in real life according to Snartum. Each sub

collider also controls light intensity of their corresponding amber, giving players a visual hint on where to aim.

It is also possible to change the fire spread and extinguishing rate, as different materials and objects burn at different rates and intensities. Making some objects easier to extinguish than others. As it stands, the flames will only grow locally, which is not ideal, as flames get hotter, they tend to spread and ignite nearby materials. This will be implemented in future versions of the simulator. But as it stands, it conveys the most important parts of the extinguishing dynamic, being the importance of aiming at the source of the fire and using a sweeping motion when extinguishing.

4.2 Smoke system



Fig.16 Fire and smoke in corner of the office

The smoke system is created mainly in order to give visual clues and stress the player out when assessing the dangers of the fire. Size of the smoke shows whether or not the flames are extinguishable. Here a particle effect is placed on top of the Fire system that spreads over time. If the player finds themselves in the smoke, a vignette effect will activate on their HMD

and occlude the player's vision, while at the same time playing audio of coughing to indicate to the player that it is dangerous. It was also planned that the player should have a HP bar that damages the player when standing too long in the smoke. But this was scratched by demand from SP. Instead, a timer displays how many seconds you are in the smoke, as a form of feedback for the player.

4.3 Fire Extinguisher



Fig 17, Left extinguisher is from BrannVRn and the right one is NORTRONIK TS6F SUPER.

Fire extinguisher is modeled after the real extinguishers found at SP offices, this being NORTRONIK TS6F SUPER [REFERENCE APPENDIX]. The virtual extinguisher was designed to have the same extinguishing range and empty time as its real counterpart. It is also outfitted with a pressure gauge acting as the visual indicator of how much foam is left. To activate the extinguisher, a pin must be released, as stated earlier. Failing to remove the pin activates a visual cue that highlights the pin, and plays an audio cue to guide the player.

Through game testing, it was reported that the hose was too distracting, as it was behaving strangely when teleporting, consequently breaking the immersion. Making it transparent,

alleviated this distraction. Limitation of the HMD pixel density also created a challenge for displaying the text and instructions. Therefore all unnecessary information was removed from the graphics so the instructions could be scaled to an appropriate size. Game testing also illuminated the need to scale up and relocate the Muzzle handle and safety pin in order to make it more reachable, as gripping small objects in VR can be challenging. The extinguisher emits particles from the muzzle, as mentioned earlier, but uses invisible spheres acting as bullets to deal “Damage” to the fire system.

4.4 Fire Hose

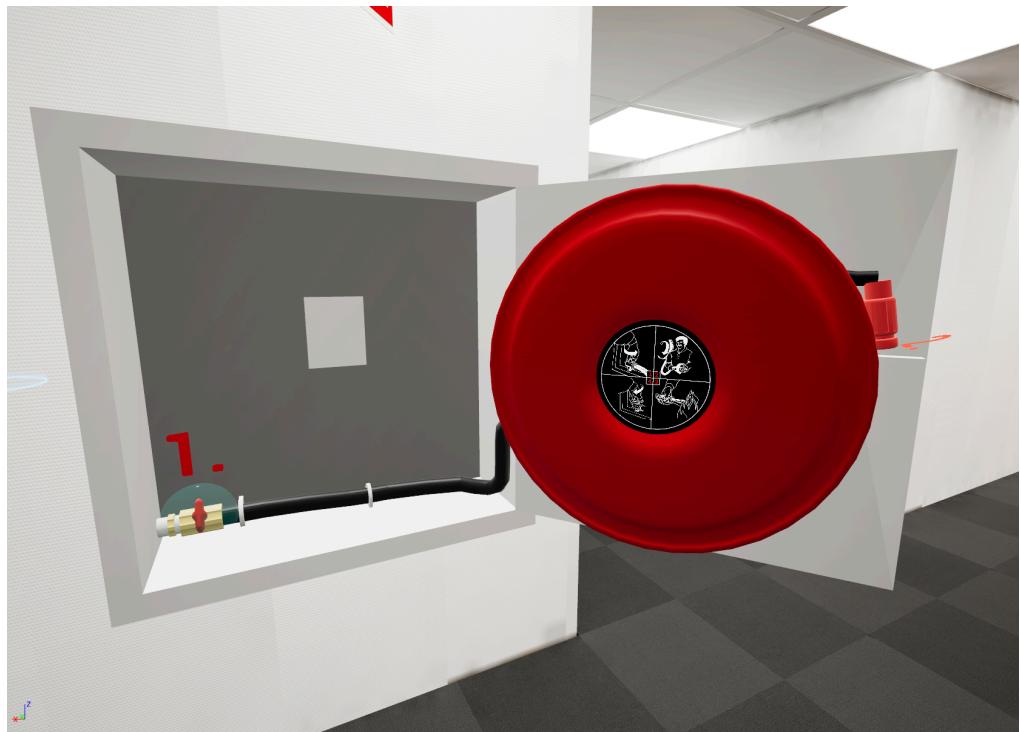


Fig.18 Fire hose

The fire hose is operated as its real counterpart. Opening the cabinet door reveals the main valve, drum and muzzle. Grabbing onto both the valve and muzzle activates an animation, showing how one could turn it on in real life. Main difference being that the simulated hose is simplified, specifically the adjustment of muzzle water spread. Instead of having a different spread radius, as one turns the muzzle, it simply activates, acting essentially in the same way

as the fire extinguisher. Difference being that the range of the water is substantially increased. Instructions are written on the drum on how to operate the hose, and more clearly shown in **fig.18**. Accommodated with numbering that corresponds with the instructions. Activation spheres surrounding the valve and muzzle act as a toggle switch when grabbed, and are consistently used to indicate interactability, more on this further down. These replace hard to grab objects, like the valve. The Valve, drum and muzzle have been simplified, as this makes it easier for inexperienced players to operate.

4.5 Fire Blanket



Fig.19. kettle on fire and fire blanket covering the kettle

The fire blanket is heavily simplified, grabbing onto the dispenser spawns a cloth simulated blanket. The player can then grab it and maneuver it and for simplicity, gravitation has been disabled on the blanket. so it will stay in the air when you release it, this is to increase ease of use. Overlapping the blanket onto a flame, as seen in **fig.19** despawns the cloth simulated blanket, and replaces it with a static blanket that covers the burning object, and extinguishes the flame. It is very simple and easily handled in VR.

4.6 Alarms and door openers.

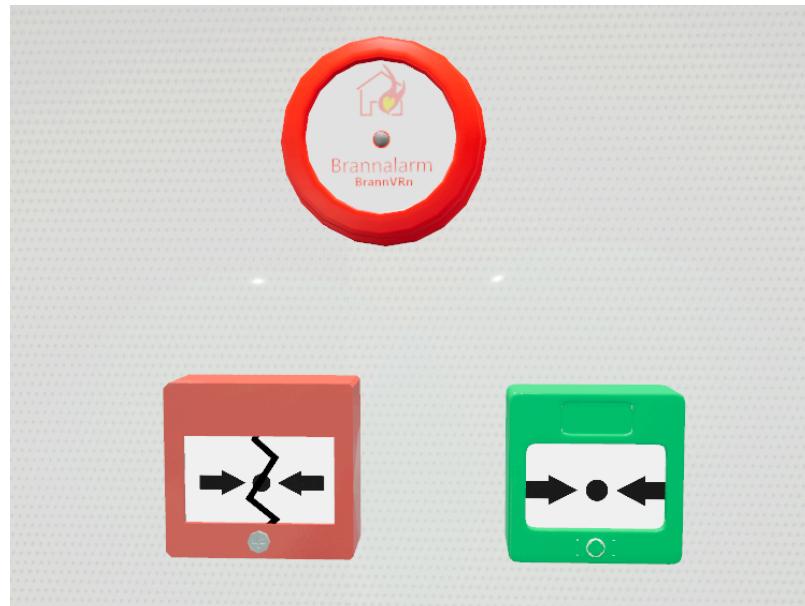


Fig.20. Fire alarm button, escape button and fire alarm bell

The emergency system works as it would in real life, only more simplified. Grabbing onto the alarm activates it, displaying a clear “broken” decal. This decision was made after extensive feedback from game testing where people reported that the activation was not visually visible. The Red Emergency box activates the alarm, and plays a loud and stressful fire alarm, and the bell will start to vibrate, as it would in real life. Meanwhile, the green box is an emergency door opener, activating this box will open the emergency doors, giving you access to the exit teleports.

4.7 Overview

Above, are some of the most important gameplay assets, these are the core of the simulator, and have taken the most time to construct. Much time and dedication has gone into creating assets that are as close to their real counterparts, while being as user friendly as possible for inexperienced VR players. Game testing cleared up lots of design issues, and made it into very user friendly assets.

5. Scenarios

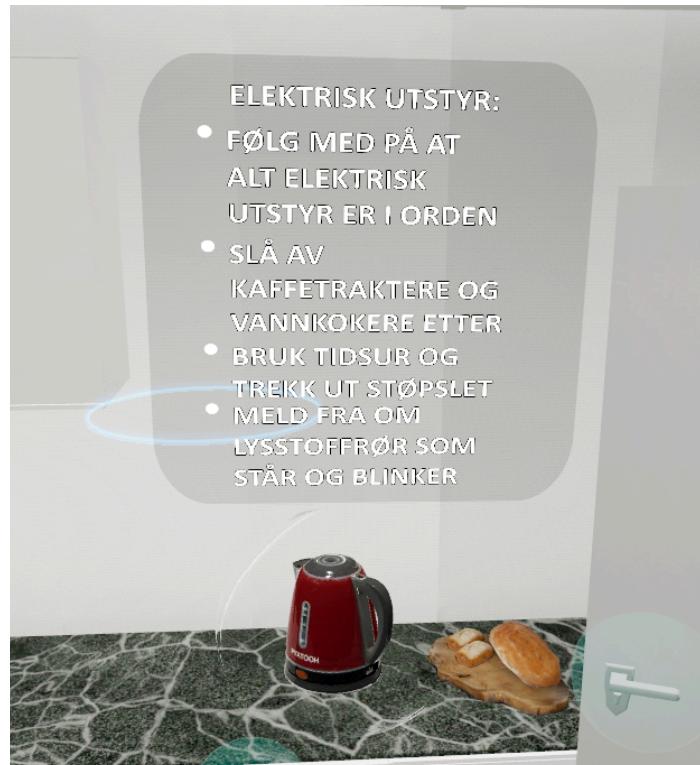


Fig.21. Infobox over kettle

In the blog from NOHA, Jonny Kaspersen writes about the 5 most common pitfalls when evacuating and clearing the premises. These five pitfalls consist of "poor knowledge of your own building, absence of practical exercises, unclear procedures, insufficient signage and marking and an evacuation plan that is not up to date" (Kaspersen, 2019). For the simulation, this is a big part of what is wanted to be emphasized in the training. It is desirable that the employees at SP should be able to get a better knowledge of their office building and their clearing routes. The aim is also to provide a form of practical exercise that does not put users at any risk. Users try everything without adding additional cost to the company in terms of equipment used. The aim is for employees to get used to and familiarize themselves with evacuation procedures.

This section will cover the main scenarios of BRannVRn. SP requested that each protocol of Assess, alert, rescue, evacuate and extinguish be gamified. Introducing the main gameplay as such. Many of the fire situations are made a little unrealistic, as it was requested by SP that all sprinkler systems be removed from the simulation in order to increase preparedness.

First scenario covers the localization of all fire equipment and general information on each equipment. The information has been gathered directly from the online fire safety course and turned into infographics that pop up when you are near the corresponding object. Players are subsequently given a task list of objects to discover in the office. This is to create an awareness of existing fire equipment and educate the staff on fire risks. Then when the player is done, they can exit scenario one using the emergency door opener, and be promptly teleported through the escape routes. It will be covered further later on.

FINN UTSTYR	
SLUKKER	0/1
BRANNSLANGE	0/1
BRANN TEPPE	0/1
BRANN ALARM	0/1
DØR ÅPNER	0/1
BRENNBART MATERIALE	0/1
ÅPEN FLAMME	0/1
SIGARETTER	0/1
VINDUER	0/1
KART	0/1
ELEKTRISK UTSTYR	0/1
SIKKERHETS VEST	0/1

Fig.22. List over tasks for first scenario

Second scenario will test the players ability to assess the situation at hand. Scenario two has five maps that the player will randomly be teleported to. It consists of two evacuation sequences, where the flames are dangerous to extinguish. And the three remaining maps are extinguishable. Effectively merging two scenarios in one. This is in order to test the players ability to assess safety in a highly stressful environment. In scenario two, all maps are advised to evacuate, but the player will not be punished for trying to extinguish “safer” fires

Snartum pointed out that even a small fire is dangerous to extinguish, and should be handled by the fire department, especially if smoke has started to develop. But it gives players a chance to try to extinguish in a safe virtual environment.



Fig.23. Rescue doll for last scenario

Last scenario is the rescue sequence. Here a training dummy is placed right by a dangerous fire, simulating an unconscious person. As per protocol, rescue of an individual is prioritized above evacuation, if the situation allows it. The scenario places an “unconscious” person right by a big kitchen fire making extinguishing impossible.

6. Escape routes



Fig.24. Main entrance start of evacuation

Lastly, the office has three escape routes that lead to a meeting point outside of the building. To save time and to educate players, 360 pictures were taken from each escape route leading all the way to the meeting point. The pictures were carefully gathered to make the transition from VR to 360 pictures as seamless as possible. Pictures were taken with a 360 camera every 2-5 meters, all the way to the meeting point. Pressing the grab button takes you forwards, and lets you exit at your own pace. When reaching the end, the player gets teleported to the lobby area.

7. Technical requirements and optimization

This simulator was created on a high end desktop, this is recommended as low framerates will lead to a bad player experience, and potentially nausea. During optimization, it was discovered that shadows in Unreal Engine 4 used most of the resources. So this was promptly turned off after lots of debugging. This project was designed to be used specifically for SP's existing equipment.

Desktop Requirements:

CPU

- Minimum Intel I7, 7 generation or up.

GPU

- Minimum NVIDIA GTX 1080 Ti.

HMD

- Oculus Rift

8. Conclusion

This project has been scoped to be created in a span of only 5 months, so compromises had to be made. BrannVRn needs some more time to be production ready, and more levels need to be added. Additionally if we had more time, we could add more mechanics, improve on almost all existing assets. Do more work on creating more high quality assets. And even taking better 360 pictures, using a better camera. Later also adding an animated controller, or better yet, replacing the controller with kinematic arms, to increase immersion further. Sound design is also something that was lacking, as none of us had competence doing sound design. Also, expansion of the fire system is highly desired to create a more dynamic and groundbreaking fire simulator. Lastly, we want the project to be expanded to support all HMD on the market, and potentially creating a universal fire safety simulator for more than just SP offices.

Sykehuspartner requested a VR simulator that gamifies existing fire safety protocols, and we believe we have delivered on almost all of their requests. Development started in October 2021 with pre-production, and lasted all the way until the middle of May 2022. This project shows great potential for future fire safety training, and will be used by SP to actively train employees. And potential expansion may lead it to reach many offices and hospitals in Norway!

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Appendices

1. Project files (Only available on USB stick)
2. Adobe XD files (Only available on USB stick)
3. Maya files (Only available on USB stick)
4. Substance painter files (Only available on USB stick)
5. Procreate files (Only available on USB stick)
6. Game design document
7. BrannVRn - Art bible
8. Instruction for use document
9. Video walkthrough of the game (Only available on USB stick)
10. Group contract
11. Sykehuspartner Fire safety E course
12. Free assets used