

Digital Reconstruction Spaç Prison

A Major Qualifying Project

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Abstract

Our team worked with Cultural Heritage without Borders - Albania, a non-governmental organization focused on restoring Albanian cultural heritage, to design and implement the framework of the application version of an existing Albanian Spaç Prison digital reconstruction project. The project's goal is to provide an accessible resource that draws attention to the Spaç Prison as a historical site. This will help bridge the disconnect between older generations recounting the traumas experienced and newer generations understanding the significance and history of the site. The framework serves to create a narrative that encapsulates both the significance and mood of the Spaç Prison. Survey results showed that our team succeeded in illustrating the significance of the prison.

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1.0 Introduction

Over the course of centuries, the landscapes of some historical sites across the world have been changing to the point where they are becoming unrecognizable. In the past, countries have restored historical sites to help preserve a darker side of their history. There are many nations for whom these less admirable parts of their past are well-known, such as Germany's Nazi regime and Russia's communist party under Stalin. Although many countries have these dark pasts, not all of them are so globally infamous.

Albania had one of the most brutal communist regimes in European history (Lula 2021). Although it may not be as well-known as Russia or China's regimes, it took an immense toll on the people of the nation. Starting in 1944, Albania was ruled by a communist regime led by Enver Hoxha (Semini 2016). This party's reign was characterized by its absolute control over all facets of Albanian life and government, its isolation from other communist regimes, and the tens of thousands of people they imprisoned, deported, and persecuted (Lula 2021). To the people that lived in Albania during these harsh times, the Spaç Prison stands as one of the most symbolic locations of that part of history (Semini 2016).

In Albania, the youth tend to struggle to remember the past hardships that helped shape their history because of social institutions omitting critical details that negatively impact their overall image. This in turn creates a disconnect between current and subsequent generations in understanding the ordeals and adversities Albanians had to cope with in the past. To help accommodate the current "fragmented and distorted" views of the past, organizations like Cultural Heritage without Borders - Albania (CHwB Albania) and the Albanian Ministry of Culture have prioritized preserving historical and monumental sites such as the Spaç Prison (Late & Sullivan, 2020).

In 2007, the Albanian Parliament declared Spaç a cultural monument, but looting has plagued the prison for years, and several buildings have completely decayed over the last two decades. Cultural Heritage without Borders - Albania, the sponsor of this project, has been taking extreme measures to prevent the collapse of three of the remaining buildings and to preserve for future generations the individual memories of those who suffered in the Spaç Prison. CHwB Albania seeks to restore and protect sites of cultural heritage in order to build human relations and promote human rights by reconciling with the past (Cultural Heritage without Borders - Albania n.d.). CHwB Albania believes the Spaç Prison can be used as "a resource for collective healing" for the Albanian community (Bllaci et al, 2016).

Previous work on the digital reconstruction of the Spaç Prison focused on designing and implementing a browser-based model to reach the hearts and minds of the Albanian people, and we wanted to make that model accessible on mobile devices. Mobile applications have become popular in everyday use due to their accessibility and cost-effectiveness (Islam et al., 2010). In today's society, mobile devices are an integral part of a young adult's life, as shown in a survey

conducted by Pew Research Center (2021) where they determined which age group was the most smartphone-dependent. It would be beneficial to have the digital reconstruction on a mobile application to make it more accessible to the youth worldwide. Transitioning the project to become mobile-based will help expand the digital reconstruction model’s influence on younger Albanians. With better accessibility, more people can become cognizant of the Spaç Prison’s historical significance in Albania.

Smartphone dependency by age

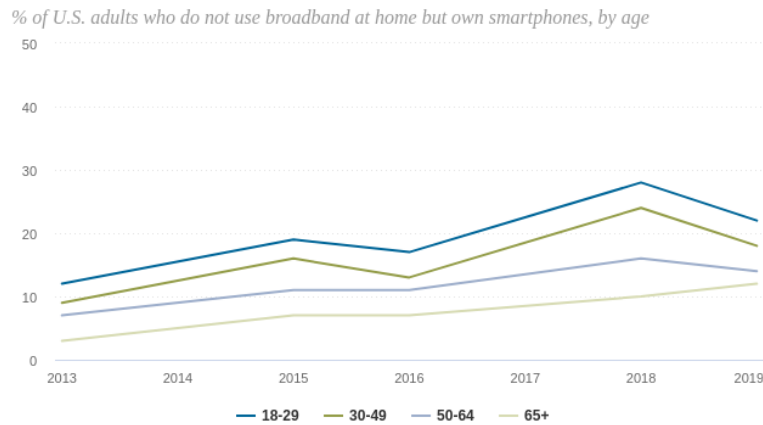


Figure 1: Statistic on smartphone dependency in the United States done by Pew Research Center (2021)

To build the application version of the digital reconstruction model, our team focused on how to illustrate the struggles that had happened in Spaç. Before we could start work, we had to understand why and how this project was important and beneficial to our sponsor—CHwB Albania—and the wider public. After that, we gathered information on how other digital reconstructions were designed. Next, we evaluated the current state of the browser version of the Spaç Prison model and determined what aspects could be improved. To garner the attention of people using the application, we decided to design a narrative where the user will read about a Spaç prisoner’s experience as they navigate through the prison. By completing the following three steps, we were able to create a foundation for future teams to build on and create an application that is both informative and immersive.

2.0 Background

2.1 Communism in Albania

Ending in 1991, four decades of communist rule left its mark on Albania, and continues to influence it to this day. During the 20th century, dictator Enver Hoxha led the Albanian communist party in turning the country into an isolated state that oppressed its own people. Few foreigners were allowed into the country, and few Albanians were permitted to leave it (Bogdani 2020).

Albania's regime mistrusted its communist neighbors. They would break ties with the Soviet Union in the late 1950s and would side with the People's Republic of China in the coming years. In 1967, to further isolate the country and secure control over its people, the regime would declare Albania an atheist state and ban religion. Albania would split ties with China in 1977, leading to further isolation and purges of groups who were identified as threats to Albanian nationalism (Brady 2019).

Playing a key role in these purges was the Sigurimi. The Sigurimi was a group that functioned similarly to East Germany's secret police, spying on the population. The Sigurimi focused on identifying and crushing ideological and political opposition to communism in Albania. To avoid suspicion of being anti-communist, members of the Sigurimi sought to continuously produce results, and they often provoked individuals into criticizing the regime just to arrest them at a later date.

The communist regime operated numerous prison camps, where it sent people who resisted the regime or who might harbor anti-communist ideas (Semini 2016). Albanians could be arrested and sentenced to more than ten years for crimes such as leaving the country for a handful of days or criticizing the regime in private diaries (Bogdani 2020). Conditions in these prisons were brutal, with little regard for the prisoners' health. Thousands of Albanians would be sent to these camps, with many remaining imprisoned until the fall of communism (Semini 2016).

2.2 The Spaç Prison

Located in a remote village of Spaç in northern Albania, the Spaç Prison is slowly slipping into obscurity. The large prison was constructed to serve as a labor camp, where imprisoned criminals and opponents of the regime were forced to mine copper in horrendous conditions. The site holds significance both to the people who were imprisoned there as a major influence on their lives and to the whole nation as a symbol of the horrors of the regime.

The prison began operation in 1968 and would close just under a decade and a half later in 1982 (Sites of Conscience 2018). The prison needed little security, as the remote location and harsh environments surrounding it made escape virtually impossible. When prisoners revolted

and seized control of the prison, the regime simply halted deliveries of food and water until the prisoners were forced to surrender, just three days later. The harsh environment also posed a challenge to Albanians seeking to visit family members imprisoned in Spaç. Prisoners would advise their families not to visit in the winter, when the weather made the climb up to the prison dangerous.

Prisoners were packed into cramped rooms that could hold as many as 54 individuals (Semini 2016). They were given a strict quota to meet every day in the mines, and failure to meet the quota, or any disobedience, could see a prisoner sent to isolation cells. These small cells left inmates even more exposed to the harsh weather, without the warmth of their fellow prisoners. The inside of the mines could be over forty degrees celsius, while the prison outside was below freezing.

2.3 Lingering Influence of Communist Albania

Whenever a social or political structure undergoes massive change, the lives of the affected people do not immediately return to how they were before. Time and effort is needed for the populace that was affected by that structure to heal, especially in a situation as bad as Albania's. The people most heavily affected are owed reparations (Bogdani 2020). Steps must be taken to make sure the tragedies that occurred are never repeated. People must acknowledge and understand what occurred in order to make it right (Sites of Conscience 2018). In Albania, it sometimes seems like more steps are being made to hide the past than to address and repair it (Bogdani 2020).

Some of these issues are incidents of neglect and a lack of clear effort to make right the wrongs of the past. The condition of the Spaç Prison itself is one example of this. As reported by Sites of Conscience in 2018, the Spaç Prison "has been abandoned, looted, vandalized, politically misused, and recently exposed to a dangerous cohabitation with one of the biggest mining ventures in the country" (Sites of Conscience 2018). Not only is this reuse of the Spaç mines for commercial mining purposes dangerous to the preservation of the Spaç site historically, but it is also seen by some as immensely disrespectful to those who were imprisoned or died there (van Gerven Oei 2015). Even the international groups that visited the location from the U.S. and Germany did little beyond report its poor state of repair (Semini 2016).

Another example of this is the nearly three decades it took to open a "Museum of Secret Surveillance", which tells the stories of the Albanian secret police used by the communist regime and the people they convicted (European Museum Forum 2021; Sites of Conscience 2018). This neglect has spilled over to the reparations owed to those who lost many years of their lives wrongfully imprisoned by the communist administration. It was not until 2007, almost 17 years after the regime fell, for the government to pass a law to repay these prisoners. That payment was then split into eight parts, and within five years of the law being passed, only one of those parts had gone through (Bogdani 2020).

In other cases, it seems like this inability to address the past was more deliberate. This is particularly notable surrounding the case of the Albanian secret police's files. These files were not opened to the public for well over 25 years after the fall of the communist regime (Erabara 2019). When first requested to declassify these files, the part of the government that controlled them, the (State Intelligence Service) SHISH, refused to do so even after Albania's Freedom of Information Commission ordered them to "open the files and reevaluate their status as secret" (Erabara 2019; Secret Intelligence Service n.d.). Even when the files were publicized, it was only a fraction of the amount there had once been. One director of the archives, Kastriot Dervishi, even said, "A good portion of the files was destroyed in the early 1990s" in an interview with the Balkan Investigative Reporting Network (BIRN). These files were kept intentionally closed for many years by various politicians to be used as tools against other politicians (Bogdani 2020). In cases like this, a failure to address the past is much less neglect or carelessness and much more an intentional obscuration of the past.

2.4 Importance of the Digital Reconstruction

An inability to face the darker times of a country's history can have horribly negative consequences as time goes on. This has been shown throughout history in several European countries that have not confronted the past, including both Romania and Spain. In Romania, large numbers of files from the secret police of their communist regime—which ended in 1989—were never made public (Bogdani 2020; The Editors of Encyclopedia Britannica, n.d.). As a result, there are people who believe the country's revolution was staged, where the public dictator and a few high-profile party members were thrown out while the rest held onto power behind the scenes. Spain was another country that had a dictator, ruling from 1939 to 1975 (Bogdani 2020; History.com Editors, 2009). A judge who investigated that era of Spain was accused of ordering illegal wiretapping and was found guilty. This has led a number of Spanish citizens to believe it was a conspiracy to suppress the truth of the past. Some even hold out hope for international courts to continue that judge's work (Bogdani 2020). In both of these examples, we see once harshly-ruled countries face consequences for a lack of ability to directly face their past.

This holds true when we look at Albania as well. The inability of successive governments since 1991 to directly face the past in any confident manner has caused some of their citizens to lose faith in their government (Semini 2016). For example, with regards to the preservation of the Spaç Prison, one former prisoner has said, "We're hoping Germany or the United States can help us turn this place into a museum. Forget about our government" (Semini 2016). The nation's inability to repay their prisoners has resulted in many of them going hungry or homeless. In one notable instance, some former prisoners were even forced to take up residence in an abandoned locker room of an old sports team (Bogdani 2020). Over time, victims of this era have gotten more and more desperate about these types of situations. In one instance, a former

prisoner died from their burn wounds after he lit himself aflame to draw publicity to just how bad the situation was (Bogdani 2020).

Roads to healing always need to start somewhere. Even though it can be criticized for being late, Albanian civil society has begun to make progress towards addressing the past. This ranges from opening up the secret police files to opening up museums and addressing some of the degraded historical locations, such as Spaç Prison. In this last step in particular, one of the most significant groups to note is CHwB Albania. They intend to revitalize the Spaç Prison in order to use it to help the country's recovery process in several ways. Beyond just honoring the memories of those who were imprisoned in Spaç, CHwB Albania hopes to use the location as a way to open the dialogues and conversations about what has happened in the past (Sites of Conscience 2018). In this, it looks to confront and address the suffering of the people directly, bringing closure to this chapter of the former prisoners' lives. Even if it may not be able to improve their living situations directly, CHwB Albania wishes to use this as an educational tool to inform younger generations of what happened and how to prevent it from happening again (Sites of Conscience 2018).

As CHwB Albania is the sponsor of this project, this digital reconstruction plays a role in these plans. It is intended to serve as a way to make this historical site accessible to everybody who may not be able to visit it in person, especially younger people who have not experienced the communist regime and therefore are disconnected from the older generation. The digital reconstruction is intended to eventually be made into a mobile app, so it will be more accessible for young people.

3.0 Design

3.1 Inspirations

Digital reconstructions are an essential tool to preserve historical sites and can be used for education, analysis, and documentation purposes (Nicholls, 2015). As technology advances, digital reconstructions are able to exhibit realistic and immersive visualizations that help capture the essence of the original site while making the experience more accessible. People worldwide can access these digital reconstructions on all platforms such as mobile devices and personal computers (Rambaran-Olm, 2015). As mentioned by the previous MQP team, "The digital reconstruction of the Anne Frank house ... serves as a perfect example on how this form of media can be a unique tool for exploration, education, and documentation" (Late & Sullivan, 2020). In this virtual tour, you are able to navigate through the various rooms in the Anne Frank House by interacting with objects in each room. Interacting with each object will provide information on said object and its historical role in the house. The exploration of the model creates an immersive effect that makes moving through the environment a more streamlined process. Both interaction and exploration help make the storytelling much more impactful. These exploration aspects would be useful in the Spaç Prison digital reconstruction model to act as a hook that captivates users' attention and keeps them interacting with the reconstruction. The virtual tour is web-based and is compatible on all platforms. To further expand on the immersion, a virtual reality version of the Anne Frank House was released in 2018 and is available as an application in the Oculus Store. The storytelling, exploration, and accessibility are key aspects we considered when designing the application version of the Spaç Prison digital reconstruction.

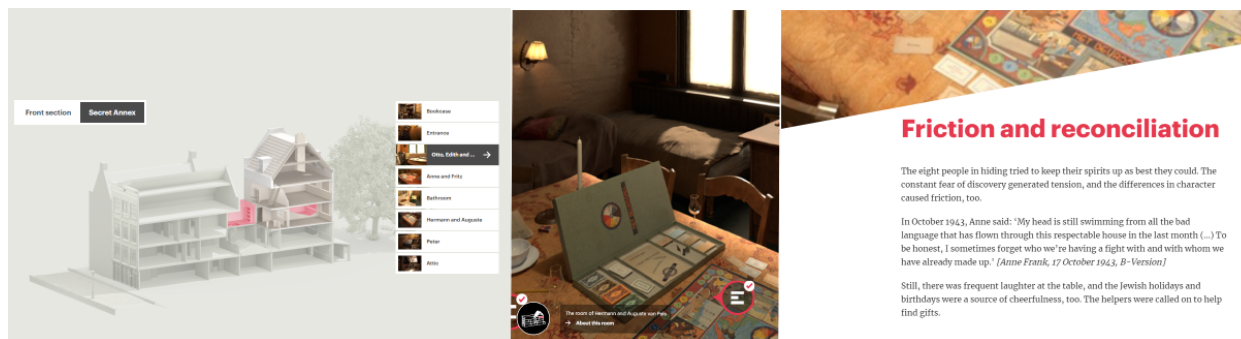


Figure 2: Anne Frank digital reconstruction model: left main menu highlighting each room in the house, middle navigation of the room, right information detailing the room the user is in.



Figure 3: Side-by-side main menu comparison of the web-based version of the Spaç Prison digital reconstruction model and Syrian military torture prison digital reconstruction model.

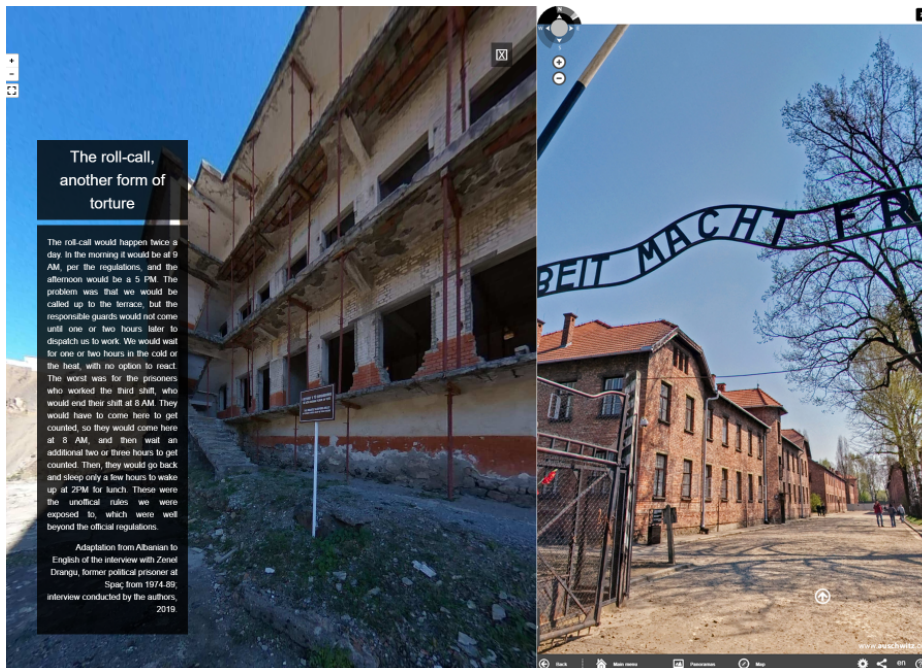


Figure 4: Side-by-side navigation of the web-based version of the Spaç Prison digital reconstruction model and Auschwitz concentration camp digital reconstruction model.

From previous works on the project, a bird’s-eye view of the prison was implemented, and this closely resembles a feature of the Syrian military torture prison digital reconstruction model at <https://saydnaya.amnesty.org/> made by Amnesty International and Forensic Architecture. When zooming into and entering any rooms in the prison, a panorama was used to navigate that particular room, and on the left hand side there was textual information of the significance of that area. This panorama implementation was inspired by the Auschwitz

concentration camp model. In the fall of 2020, a pair of WPI students further optimized the Spaç Prison reconstruction model to be much more responsive, significantly reducing the load times. The students also helped improve the User Interface and User Experience (UI, UX) , for which they have addressed the following:

- Axis of Rotation: Created focal points for the user to view upon double clicking, which allowed for further exploration of the model without the user feeling restricted.
- Camera Movements: Restricted camera movement to prevent glitches and model distortion.
- Label Feedback: Provided target source to all sections of the model and provided visual feedback for the user to easily navigate through the digital reconstruction model.
- Visual Improvement: Maintained a consistent font, color theme, and grouped sidebar elements to ensure visual continuity for the digital reconstruction model.

These UI/UX implementations on the web-based reconstruction are integral for developing good Human Computer Interaction (HCI) and should be adopted when transitioning the digital reconstruction to exist as a downloadable application instead of as a website.

To develop the Echoes of the Past theme, we used the interactive storytelling game *What Remains of Edith Finch*. *What Remains of Edith Finch* tells the story of the Finch family, and the user plays as the only surviving member trying to unravel throughout the course of the game how each family member died by reading memoirs of their past, later deducing the cause of each family member's death. The dialogue and interaction in the game evokes a grim ambience and gives uniqueness to the characters presented. For our digital reconstruction model, we created an effective narrative that will create the same effect, so the model can both inform and evoke emotion for those using it. For our narrative, the user explores the life of a Spaç prisoner as they recount their hardships in the prison. The storytelling of *What Remains of Edith Finch* gave the team a sense of direction on how to effectively present historical information about the Spaç Prison while maintaining a feeling of hopelessness when exploring the model.

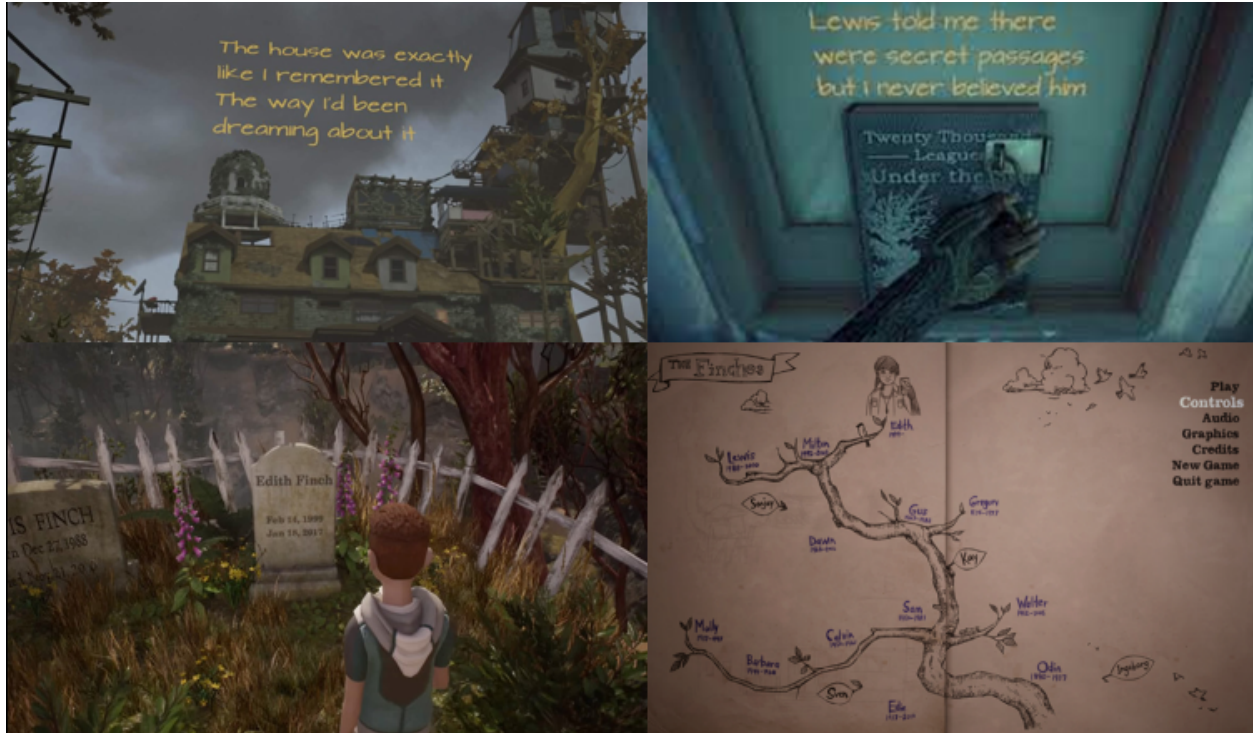


Figure 5: Gameplay footage of *What Remains of Edith Finch*

When thinking about creating a digital reconstruction model that uses captivating environments to guide the user, we considered using the exploratory puzzle game *Myst* as a point of reference. *Myst* encourages users to pace themselves as they explore, solve puzzles, and finish objectives assigned in the game. The lighting, texturing, and post-processing helps to create these lush environments that give a sense of immersion to users playing the game. In the digital reconstruction, the environments should be both immersive and accurate to the actual Spaç Prison site in order to garner attention and educate users interacting with the model. We would want these users to take the time to truly understand the struggles that lie within the Spaç Prison. Creating an aesthetically pleasing environment will give visual feedback that will help complement the overall narrative and mood of the digital reconstruction.

3.2 Initial Plans

When we first started working on this project, we had an opportunity to overhaul the entire project, as we were moving from a webpage to an application. This meant we had to decide on how the players were going to explore and experience the Spaç Prison. The previous version had a top-down view of the model of the prison, and the user could select various locations to see a panoramic view of and read more information. This was not entirely viable for us, however, as the panoramic image assets were not usable in any 3-Dimensional environment software. Additionally, this method, while informative, could feel rather lifeless at times. We were given an idea from the notes of past groups that we could use an interactive story to make

people invest their interest in the Spaç Prison and the Albanian communist regime. This would likely take the form of something similar to a visual novel. The player would be able to make choices that would appear to affect the story of the game. We were planning to make these choices ultimately be revealed as meaningless and lead to the same ending results, thus increasing the user's feelings of hopelessness and lack of control.

We quickly realized that focusing on these choices would be out of our scope. None of us were familiar with the creation of visual novels and these sorts of diverging and converging paths. As such, we wanted to focus all of our attention on one story line, and then, if we had any extra time, work from there. Additionally, we also understood that the Spaç Prison was a large place and that we could not realistically cover the whole prison during the duration of the project. After using the work of the previous MQP, we came up with a list of five important locations within the Spaç Prison that would best tell the story of the average experience of a prisoner while also highlighting the hopelessness they felt. These locations included the following:

- The Group Cell Room/Prisoner Dormitories: Used to highlight the poor living conditions of the average prisoner and to give a location able to facilitate social interactions for future decision-making story opportunities.
- The Inside of the Mines: Used to highlight the poor working conditions and long working hours of the average prisoner, give insight into the struggles of the prisoner, and highlight the cruelty of the communist regime.
- The Roll Call Platform: Used to communicate an important daily experience of the prisoner in the roll calls and highlight how the prison and regime tried to break the prisoners' spirits and make them feel hopeless and worthless.
- The Visitor Room: Used to showcase what it was like when the prisoners met their family members, how the prison and regime tried to punish the families of the prisoners, how controlling the regime was, and how they tried to maximize the suffering they inflicted on the prisoners in every aspect of their life in prison.
- The Isolation Cell: Used to highlight the worst of conditions and mistreatment of the prisoner and maximize the feelings of hopelessness and powerlessness communicated to the users of the app.

To go along with these locations, we created a story that connected and utilized each location to their maximum effect. The story would take place over a short timespan of two days. The first day would only use the first three locations, displaying the daily life of a prisoner in waking up, going to roll call, working harshly in the mines, going to the second roll call, and then going back to bed in the poor conditions of their group cell room exhausted. Of course, due to the limited time for this project, some locations that would be important to showing daily life—such as the bathrooms—had to be omitted. Overall, we believed this was a strong representation of the poor conditions the prisoners dealt with in the way they worked and lived

on a daily basis. The second day started the same way, but gave insights into events or situations that were not uncommon within the prison. These included a visit with the family, which would take place in the visitor room, and getting punished and having to go to the isolation cell. We would then end the story with the main character of the story at their lowest point: in the isolation cell. This would maximize that feelings of hopelessness and powerlessness, especially if any choices were to be worked on in the future, whether they be added by us or by future groups.

3.3 Alphafest

In November, Worcester Polytechnic Institute holds an event called Alphafest in which IMGD students can present their projects to other WPI students and get feedback during a two-hour time period. To get an understanding of the effectiveness of our application, we created a version of the application in preparation for this event. For this iteration, we solely focused on delivering a built environment of only the Family Visitation Room where all of the assets—excluding the fence—and texturing were implemented. During the time of Alphafest, we were still finding a character model suitable for this digital reconstruction model, so we used the X Bot Mixamo character model with the ghost texturing as a placeholder for this build. The complete script for the Visitation Room was also prepared; however, it was not yet integrated into this build. To accommodate this issue, we printed out copies of the entire script for users to read over as they explored the Family Visitation Room scene.

By showing this build at Alphafest, we aimed to determine the effectiveness of the environmental storytelling in the digital reconstruction model. Specifically, we wanted to know if our assets and texturing helped strengthen the narrative we created for the model. To assess this, we interviewed students while they were interacting with the build and asked if they recognized the feeling of hopelessness that the Family Visitation Room was intended to create. Unfortunately, we did not get IRB approval in time, which meant that we were not able to collect and assess hard data. The information disclosed from Alphafest consists only of personal observations of students interacting with the application.

After exploring the environment and reading the story, the students gave us their feedback. During the time of Alphafest, there were instances where students mentioned how the character models grabbed their attention as they were walking by, and this caused them to sit in and interact with the application. After reading the script and interacting with the build, students were confused with the purpose of the character models in the environment. This observation acted as a further incentive for us to develop a character model that would better fit the digital environment and complement the Echoes of the Past Theme. For Alphafest, the general consensus made by students was that the overall quality of our work in terms of generating the atmosphere that we wanted was good, but we still had a couple more things we could improve on.

After Alphafest, we wanted to shift our focus to the following: post-processing, implementing a dialogue system, finalizing a character model, and lighting. Post-processing was necessary to bring the Echoes of the Past Theme into fruition, as the effects would help the user become immersed in the application as if they were brought back in time to experience the active state of the Spaç Prison. Implementing a dialogue system was crucial in showcasing the narrative for the user to see as they explore the application. Finalizing a character model would prevent any confusion for the user as it would blend in with the environment, making the entire scene present more naturally. Light manipulation was essential in showcasing the focal points of the scene by having the shadows make the assets more recognizable and emphasize the feeling of hopelessness. With these considerations in mind, we developed a plan to revise the Family Visitation Room and implement the Group Cell Room.

3.4 Altered Plans

It was after Alphafest that a huge part of this project started changing from our original scope and plans. Although we originally had high hopes for putting together a comprehensive story line through five locations within the Spaç Prison, we eventually realized that this was unfeasible within the time we had left. There were a few reasons for this, including that we may have just over-scoped originally. The largest problem was that our team lacked an artist, and we failed in recruiting one. With the project being a reconstruction of a real world location, this became a huge setback for us. Creating these environments now had to be done by a group of people who were unfamiliar and inexperienced in this job. Some of us did not even have any prior experience with the Unreal Engine 4, the platform we were using to create the digital reconstruction. We also did not have any ability to create assets on our own, and had to spend hours searching for free assets and learning how to import and implement them.

All of this meant that we wound up having to pivot the project to include only two of our original five environments. These two environments we ultimately used were the Group Cell Room and the Visitor Room. We chose these areas as they were some of the simpler areas to complete that still had very effective yet very different roles in communicating our story. Although they alone do not cover the whole story we wanted to cover, the Group Cell Room is an example of how we can give insight to daily life, while the visitor room is an example of a special scenario that, while not a daily occurrence for any prisoner, was not uncommon within the prison overall. To fit along with this, we wrote one scene for each environment, and tried to slightly hint at some of the poor working conditions and the arduous demands placed on the prisoners.

4.0 Development

The first step of developing our application was choosing the tools we would use to develop it. For this project, our main development tool was Unreal Engine 4. When it comes to developing 3D environments for games and other similar applications, the most common tools to use are Unreal Engine and Unity. Unreal Engine was our choice primarily because it was something that our team had more familiarity with, making it easier to get started with. It also has built-in visual and graphics tools that benefited us. For example, Unreal Engine's responsive and high-quality built-in lighting systems made creating effective lighting for our environments much easier and faster than it might have been otherwise. Additionally, the marketplace for Unreal Engine assets is built into the Epic Games Store, the same platform that you get Unreal Engine on and launch it from. This made it very easy for us to find, learn, and navigate the Unreal Engine marketplace. These things were all very important to help make the artistic aspects of this project easier for us, which was critical as we lacked a dedicated artist.

The other major tool we used was GitHub, which we used for code sharing and version control. This helped us to share our work with each other and work on different parts of the project at the same time by using GitHub's branches. It also allowed us to go back to previous versions if we made major mistakes or had technical difficulties due to merge conflicts. GitHub was our choice for this due to it being a tool every member of the team was familiar with. This meant our team could spend more time developing the application. The only major flaw of GitHub for us was the limited amount of data it could transfer. This caused us to have to store certain large texture and material files in a folder on Google Drive instead of using GitHub.

4.1 Story

Early in the development process, we realized one of the potential problems of the previous web-based versions of the project was the level of freedom they gave users. Anyone exploring the web-based digital recreation would be free to look at and read about any room in the prison in any order they wanted. While this has benefits, it is not the most engaging way for users to interact with an application, and people who are completely unfamiliar with the Spac Prison may be unsure where to start looking. To solve this, we came up with the idea of using a story to guide users through the prison, giving them an idea of what life in the prison was like.

A single story could not cover all the locations within the prison without becoming too long to hold the user's attention. With this in mind, we selected a handful of locations within the prison which we thought could effectively show off what life in the prison was like. We settled on the group cell room where prisoners lived together, the roll call platform which was a part of the prisoners' daily routine, the mines where prisoners worked everyday, the visitor room, and an isolation cell. The last two rooms were chosen because while someone living in the prison would not visit them on an average day, they show the prison's oppressive nature.

With the locations picked out, we began outlining the story we wanted to create. The story was planned to cover two days. On day one, our protagonist would wake up in the group cell, attend roll call, work in the mines, return for the evening roll call, and then spend the evening in the group cell room. This was intended to focus on the daily routine for prisoners, showing the basic living quarters they had and dangerous working conditions they faced. Day two would begin the same way, with our protagonist being brought to the visitor room instead of the mines after roll call. They would then meet with their family and afterwards be sent off the isolation cell as a result of something they said in the visitor room. We wanted to highlight how the prisoners were constantly watched by the guards and how horrible the conditions in the isolation cells could be.

When it came time to downscale the project later on, we also reduced the number of locations that would be featured in the story. The first two locations to be cut out were the mines and the roll call platform, the mines because we had very few images to base them off of, and the roll call platform because it has the least significant role in the story. We also made the decision to reduce the story to just one day, and this made it difficult to show off both the group cell and the isolation cell, so the latter was cut. The story was reduced to the scene in the visitor room and the protagonist returning to the group cell afterwards to end the day. We found that these two scenes would be the best for showing off the most important details about life in Spaç.

When we started writing the first scene for the visitor room, we were not quite certain how exactly it should go. As such, we began by outlining the main points and events for the scene to go through. We outlined the introduction that described the setting, the relevant characters entering the room and greeting each other, and a description of how the fence would block family members from reaching each other. Then we outlined the talking points of the conversation and, finally, the ending. We then had to decide how the story for this room should be written.

The first option was to use the perspective of a main character writing in a diary. In this we would write about the dialogue instead of stating actual lines said from one person to another. This would be easier for us to write as less work would be involved in making the dialogue and conversations sound natural. However, if done poorly, it risked coming off as lazy, sounding robotic or clichéd. This would take the user out of the experience, as they would think more about how no normal person would say something like that instead of thinking about what is occurring, or the tone we were trying to get across.

The other option we considered was to write as if the user was present while the events were taking place. This would let us include dialogue between characters, but had the risk of taking the user out of the game by sounding unnatural and robotic if we failed in conveying the characters' emotions. To help decide which approach to use, we consulted Interactive Media and Game Development writing professor Ben Schneider. With his advice, we ultimately decided to write this scene as if the user were there as it happened, as the scene itself consisted primarily of

the interactions between characters. He also told us that this would have the added benefit of being easier for future groups to add in-game choices and decisions.

We developed the second scene using the same process as we did the first, starting by outlining the scene in detail. Then we decided on a writing approach. For this scene, we decided to take a more diary-like perspective. There were two major reasons for this. The first was that this scene was much less driven by dialogue and character-interaction. It instead focused on the inner thoughts of the protagonist and descriptions of living and slaving away within this prison. A significant reason for this shift in focus was that we wanted to use this opportunity to have the protagonist reflect on other aspects of the prison that had to be cut from other scenes. The other reason we chose to write from this perspective was that any dialogue would be between two prisoners. This meant that this interaction could be really sensitive to some former prisoners. We had little insight into what interactions in the prison were like compared to the general lifestyle of the prisoners. What we did know was that prisoners had to be careful when talking to each other, as they could never be certain whether another prisoner served as an informant for the wardens and the communist regime that ran the prison. Prisoners could get benefits over other prisoners by selling each other out. Because we did not have any model conversations between prisoners to base this kind of careful interaction around, we felt it would be best to use the more vague writing style.

4.2 Artistic

Environmental storytelling is an integral part in communicating a narrative, as visuals and scenery make the message stronger and clearer than it would be otherwise. Since our team lacked a strong artistic background, we had to draft out how to create these visualizations for our digital reconstruction. Echoes of the Past is the idea that the user, in the present time, is experiencing and interacting with events of the main character's story in the past. It was a concept we wanted to present in this digital reconstruction, as it is an interesting and immersive take that helps the user experience and understand the adversities within the Spaç Prison.

4.2.1 Greyboxing

The team made draft versions of the environments in the Spaç Prison through a process called greyboxing. Greyboxing is a draft of what scenes—such as the rooms in the Spaç Prison—would look like. In Unreal Engine, this greboxing is done using the BSP brush tool—which allows you to create 3D geometric objects in an environment—and a list of assets. Aspects we paid attention to when greyboxing were scalability and accuracy, and the assets we would use in a particular section of the digital reconstruction. For scalability, we wanted all rooms in the digital reconstruction to be roughly the same dimensions. If the rooms were not similar in scale, the inconsistent dimensions would look out of place and potentially break the immersion for users. To ensure accuracy, we wanted the greyboxing to closely resemble the actual rooms in the actual Spaç Prison. We used the web-based version of the digital

reconstruction as a point of reference, which had panoramas of various rooms in the Spaç Prison. To help keep track of our progress, we created an asset list which contained all the objects that needed to be created and added to each of the rooms. This included minor items like piles of rubble and larger pieces like stairs and windows. The list was also used to track which items had been implemented, which still needed to be created, how important each asset was considered, and when the asset needed to be implemented. All three aspects mentioned tie in with one another, and by taking account of these aspects, we could ensure the Spaç Prison digital reconstruction model read well for people using it.

Asset	Done?	Priority	Due Date	Notes
Stairs	wip	Low		
Brick Walls	wip	Medium		
Demolished Walls	wip	Medium		Need Artist
Large Cell Walls	wip	Medium		Discuss Mate
Large Cell Floor	wip	Medium		Discuss Mate
Large Cell Ceiling	wip	Medium		Discuss Mate
Tree Stump	y	Low		
Grass/Rubble	y	Low		
Tree Stump	y	Low		
Pickaxes	y	Low		
Supports	y	Low		
Stone Slabs	y	Low		
Barred and Locked Doors		High		Need Artist
Chain Shelf Thing		High		Need Artist
Ceiling of Bars		High		Would be bes
Rollcall Building Face		High		Need Artist
Sign		High		Need Artist
Red Metal Vertical Poles		High		Need Artist
Pile of Bricks		High		
Obscuring Mist		High		Look more int
Triple Decker Bed		High		Need Artist
Damaged Bed 1		High		Need Artist
Metal Chainlink Fence		High		Need Artist
Damaged Bed 2		Low		Need Artist
Night Sky		Medium		Look More int
Elevated Platform		Medium		
Minecart		Medium		Look More Int
External Dirt Path		Medium		
Worn/Damaged Wooden Table		Medium		Look More Int
Rock Surfaces/Walls	wip	Medium		Discuss Mate
Hard Helmets w/Lights	y	Low		
Minecart Railway		High		Look More in

Figure 6: Asset List for the Group Cell and Family Visitation Room

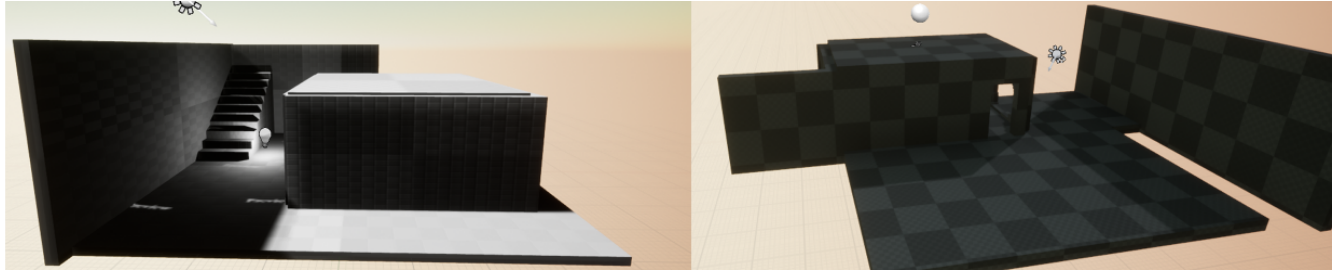


Figure 7: Greyboxing of the Group Cell Room (left) and Family Visitation Room (right)

Meshes in Unreal Engine are environmental objects, and they help with constructing the scenery. For the simpler meshes we took the BSP brushes from the greyboxing and used a built-in UE4 feature to convert them into meshes. We also retrieved premade meshes from the Unreal Marketplace, such as a bed for the Group Cell Room and table for the Family Visitation Room. This saved us time which we could focus on other features that enhanced the quality of our scenes, such as model creation and lighting.

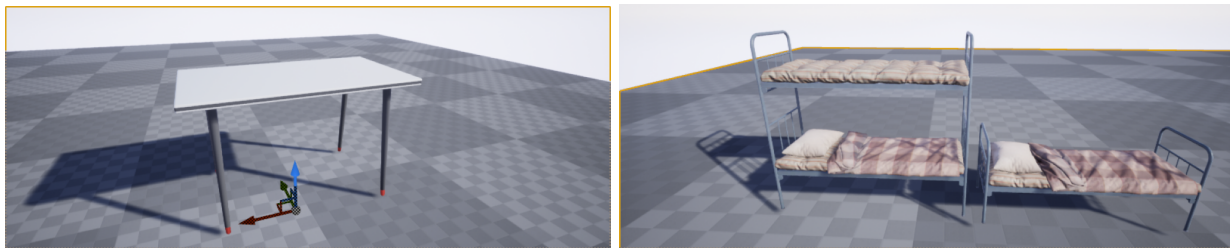


Figure 8: Premade table and premade beds acquired from the Unreal Marketplace

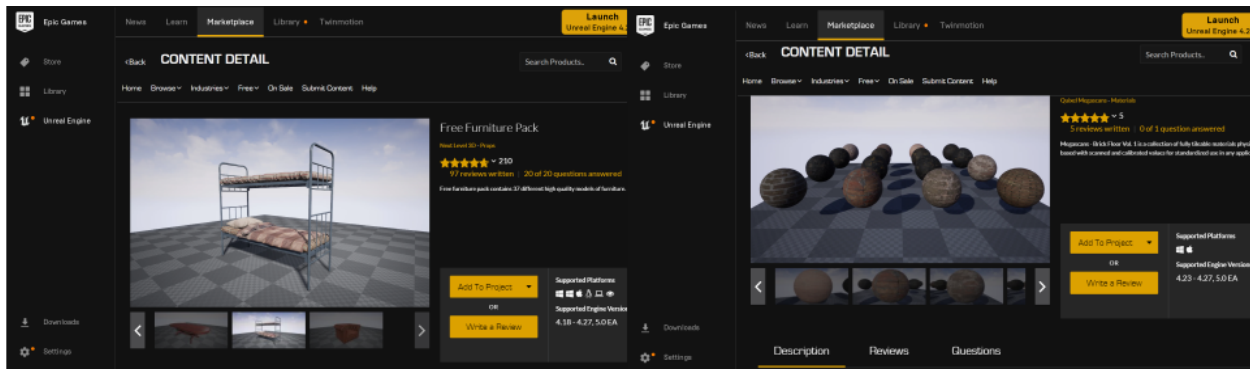


Figure 9: Premade meshes, left bed mesh and right texturing, purchased from the Unreal Marketplace

4.2.2 Textures

One of the biggest challenges we had was in the textures that we used. Our original intentions had been to bring an artist on board in the beginning of the second term that we were working on the project. They would then be able to help us with certain models and textures. We

posted a request for help to other students at WPI but received no responses, and we had to continue on our own. With no artistic capabilities to speak of ourselves, we turned to the Unreal Marketplace for textures. From the Unreal Marketplace, we picked up wooden textures for the table and several varying brick and cement textures. All of the textures that we used were Megascan textures from Quixel Scans, except for the dirt textures used in the Visitor Room, which came from Forest Landscape Materials Vol. 1 by Project Nature. The cement textures we chose were meant to be used as a replacement for old chipping paint, as we could not find any chipping paint textures, but the cement was the closest we could find to the rougher look of chipping paint. We also used a lot of brick textures for similar purposes of their rougher look. These rough looks can also help to indicate the damage and decay to the prison.



Figure 10: Close up of a dirt material from Forest Landscape Materials Vol.1 by Project Nature



Figure 11: Close up of a cement material from Megascans - Concrete Dirty Vol. 2 by Quixel Megascans



Figure 12: Close up of a brick material from Megascans - Brick Rough Vol. 1 by Quixel Megascans



Figure 13: Close up of a brick material from Megascans - Brick Floor Vol. 2 by Quixel Megascans

Another important part of choosing our textures was the number we wanted to choose. It was important for us to get several different rougher textures that we could use in the same area. Changing between textures helped to keep a flawed and dirtied look. After we found textures to use, we had to implement them by using Unreal Engine 4's migrate tool to bring them into the project, and then we applied them to the meshes that we created ourselves. A key part of making these textures work was that we had to set up the mesh properly beforehand so that the textures did not stretch. We did this by setting the surface of the BSP brush to duplicate the texture as needed to cover the full surface of the brush, instead of simply stretching the texture and messing with its ratios. This step had to be completed before turning the BSP brush into a mesh.

4.2.3 Lighting

For lighting overall, the team wanted to make the rooms of the digital reconstruction model dim, but still bright enough that everything can still be seen. This implementation helped create distinct shadows that better encapsulated the hopeless mood we wish to exhibit through our model. The use of distinct shadows allowed us to incorporate more distinct textures side-by-side because the changes between different textures became less jarring, making the overall scene read nicely. When working with the distinct shadows, we focused on applying them on assets in the scene such as the character models and the mesh objects these models interact with. This way, the focal points of the scene become more distinguishable.

To effectively dim the room, we used directional light from Unreal Engine and angled the light in a way that shows some consistent lighting and creates dynamic shadows to enhance the environment. The directional light is designed to replicate natural sunlight for the scene, helping to develop the feeling of poor conditions by removing any indoor lighting. Therefore, having the directional light represent the natural light adds more substance to understanding the physical state of the prison. Point lights were implemented to further improve the readability of each room in this digital reconstruction, and they were placed in areas of the room where it was very dark. We wanted these point lights to keep the scene illuminated in order to make the assets within the scene more distinguishable, while complementing the other types of lighting implemented. For the Visitation Room specifically, we applied flickering lights by making the light into an Unreal Engine actor. Actors are objects that can be placed inside an Unreal Engine world that have their own code carried out during the game. We edited the code (or blueprint) for this actor so that it would toggle its visibility on and off, making the light essentially turn on and off. The flickering light effect adds tension from the sporadic changes of the lights, creating a negative and stressful atmosphere. This lighting effect helps to garner the user's attention and guide them to the main focal point of the scene when they experience the longer story of the Visitation Room firsthand.

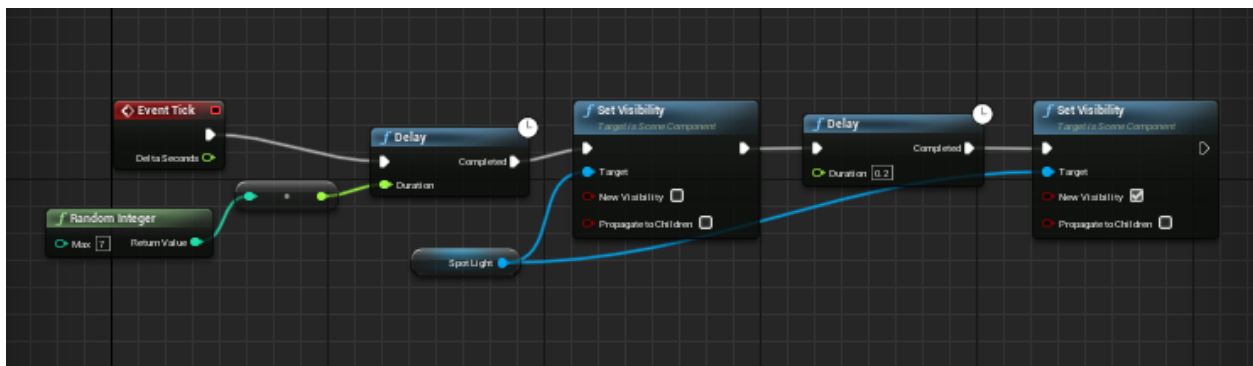


Figure 14: Flickering light blueprint

4.2.4 Echoes of the Past: Character Models and Post Processing

When deciding on character model implementation, we wanted to have the models be anthropomorphic spirit-like entities that give a feeling of reminiscence. We want users to grasp the idea that they are going back in time, and these models are connected with the Spaç Prison to help paint a better picture of its historical significance. The models also help to strengthen the narrative as they act as a visual cue when the narrative touches on the day-to-day life of a Spaç prisoner. We needed to get character models that helped the mood of the digital reconstruction, while suiting the environments in the model. As always, not having an artist meant that we had to turn to third party sources for our character assets. Since these models also required animation, an often time-intensive process, to add to the experience, it was important for us to find a tool that was efficient and easy to learn and use for our group who had no prior animation experience. For this, we used Mixamo—an open-source online database of characters and animations—as a resource in auto-rigging, animating, and obtaining our character model.

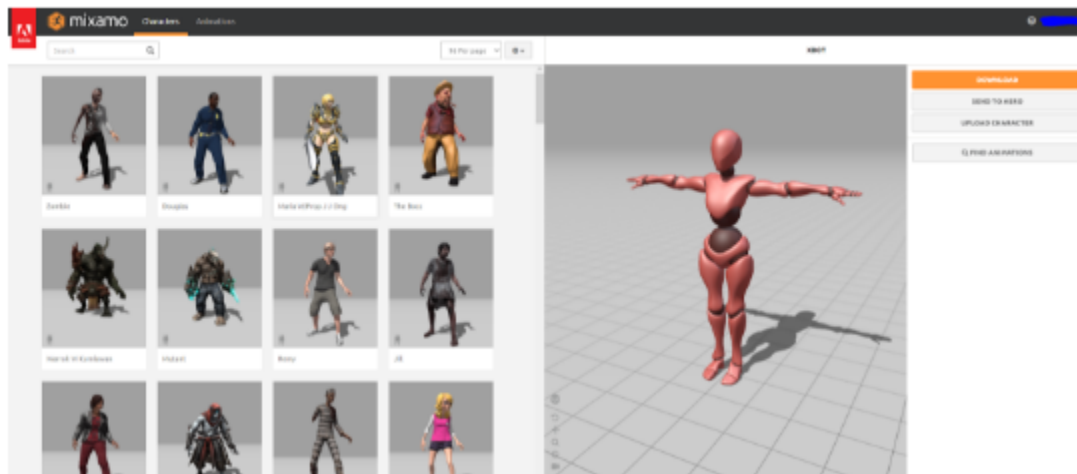


Figure 15: Mixamo character model library

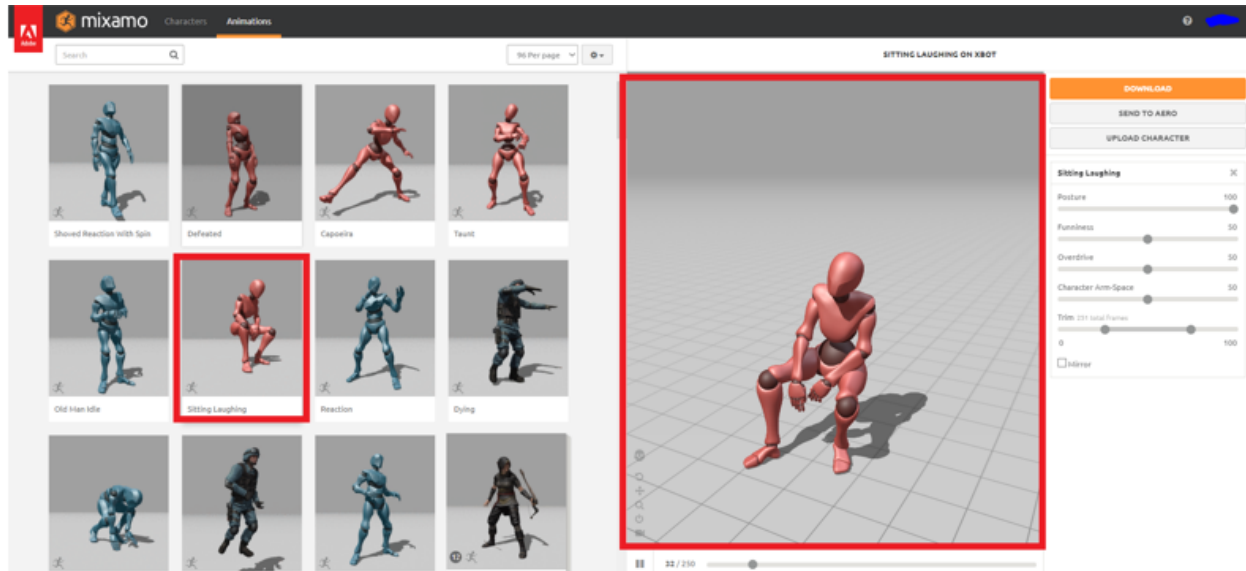


Figure 16: Mixamo animation library; a user can preview the animation on the right side of the screen highlighted in red and rotate the model to one's liking

During the preliminary phase of implementing the character models, the models themselves resembled androids, which took away from the overall mood of the scene. To get a more human-esque feeling out of the character models, the team purchased models from Turbosquid, a company that sells 3D stock models, as a resource to obtain a simple low-poly base mesh human object. The low-poly base mesh human object we purchased was \$10.

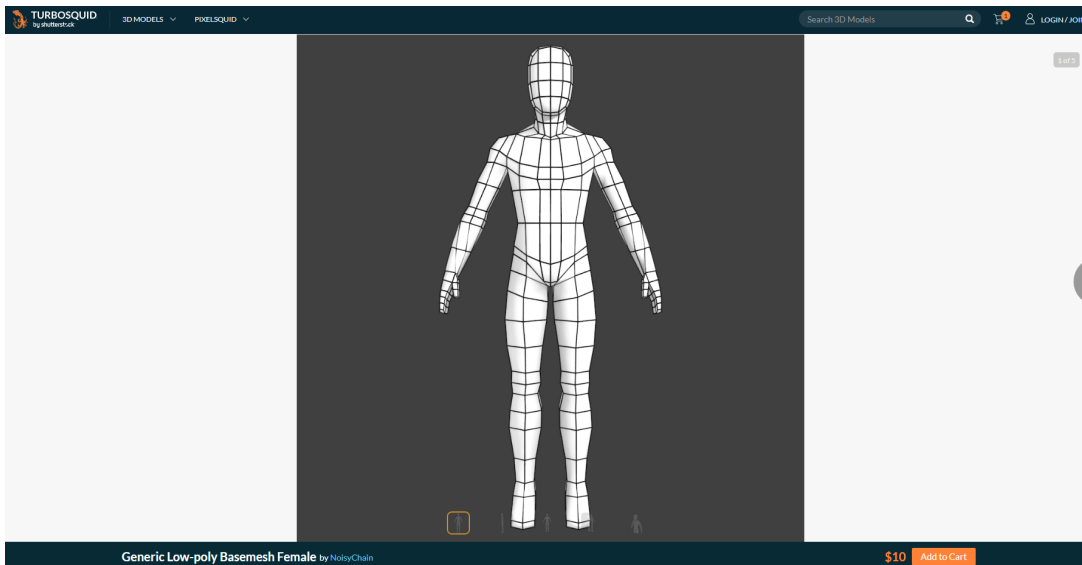


Figure 17: Purchasing low-poly mesh human object from Turbosquid

We then used Mixamo to auto rig the mesh object to build the whole human skeleton for it, which allowed us to give the model proper idle animations. Auto rigging in Mixamo is a fast, intuitive process that applies movement to a character model by pointing to key areas of the model using markers as shown in Figure 18. It is mainly used for humanoid models and is compatible with other game engines, one being Unreal Engine 4. For texturing our character models, a Fresnel material, a shader that adds a specific type of reflective effect, was made by creating a material property in Unreal Engine and playing around with the base color, emissive color, and opacity. This material helped to showcase the ghostly effect that complements the Echoes of the Past theme we aimed to achieve for this iteration of the project.

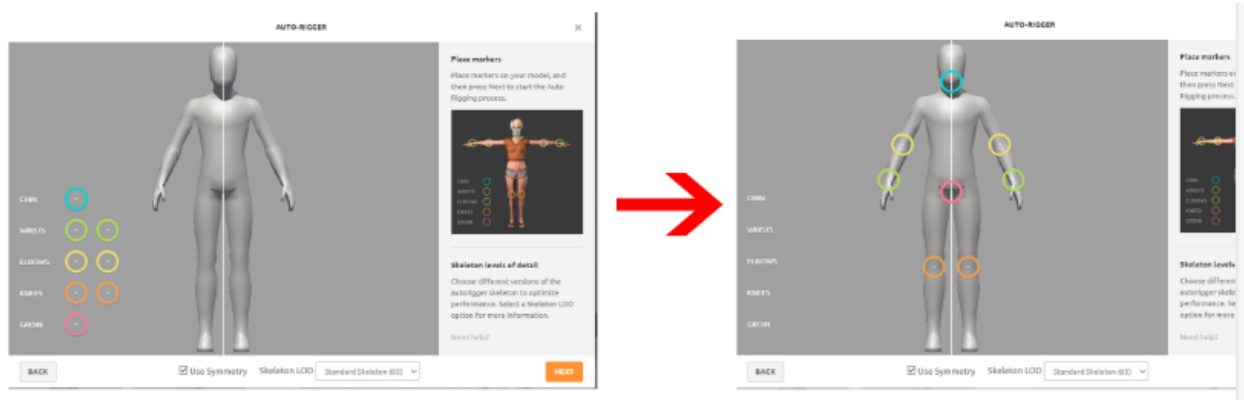


Figure 18: Auto Rigging process in Mixamo

To better consolidate the Echoes of the Past theme, post-processing effects were used to varying degrees. To implement this, we used post-processing volumes, which are cubes that surround an area and apply the effects in that area. In this model, the effects we used were Chromatic Aberration, Depth of Field, and Film Grain.

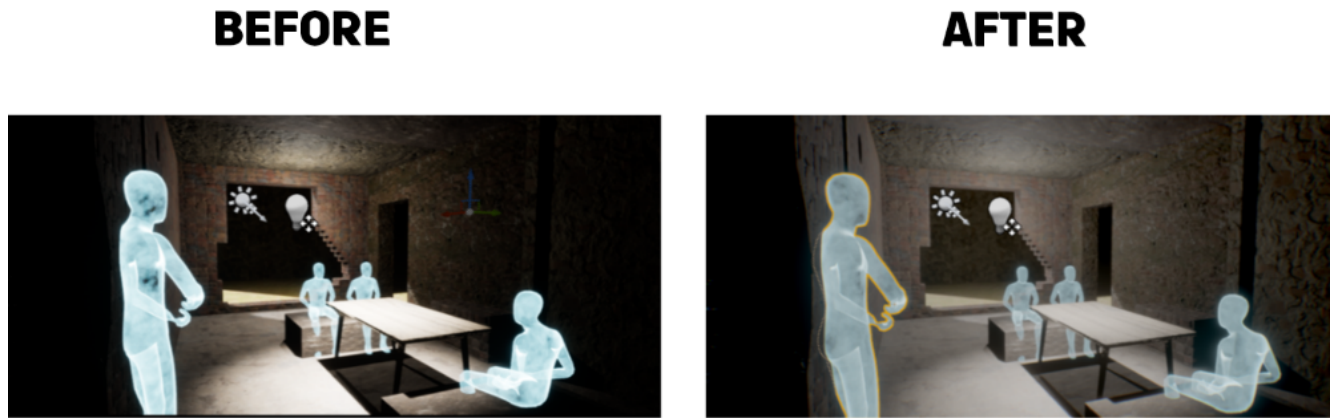


Figure 19: Side-by-side comparison of the before and after for post-processing implementations

Here is a brief explanation on what each effect does and its overall significance:

- Chromatic Aberration is the process of distorting the color of an object and creating outlines of colors around this object, similar to the 3D effect with the distinct red and blue outlines around an object. We used this effect at the edges of the field of vision to help make the room feel eerie and make the user feel like they are going back in time.
- Depth of Field blurs out images that seem to be farthest from the camera and focuses more on images that are closest to it. This effect helps to make the rooms in the Prison stand out more, as it adds more emphasis on the assets in these rooms.
- Film Grain covers the area with tiny particles and creates a fog effect. It also deepens the shadows a little. This effect helps with the feeling of going back in time that is central to the Echoes of the Past theme.

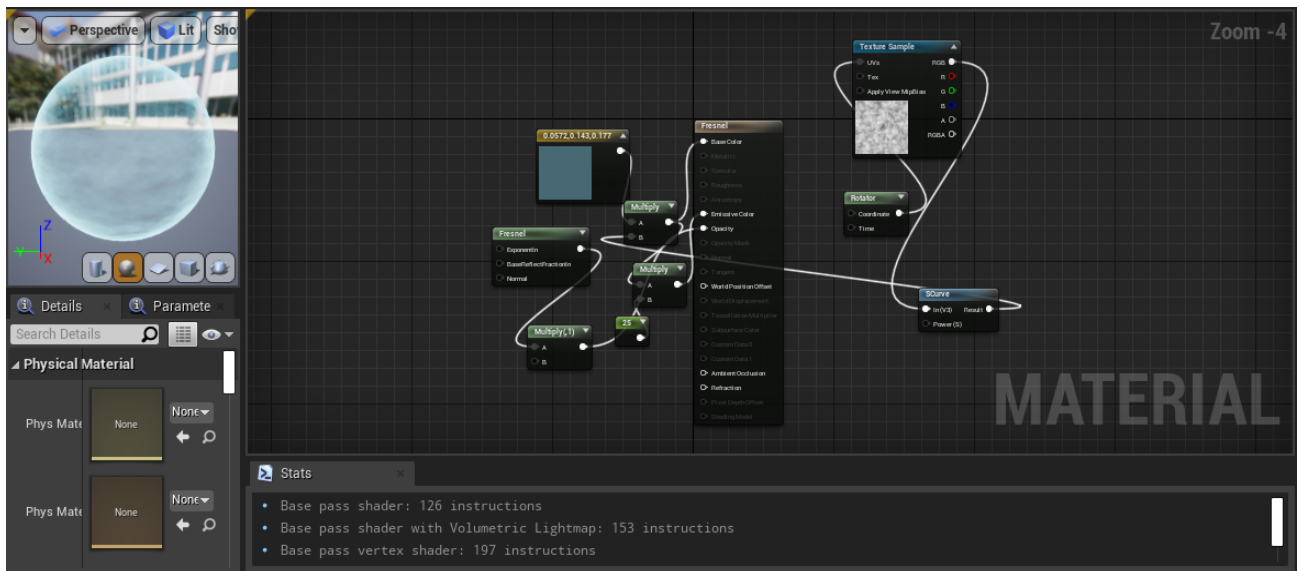


Figure 20: Fresnel material blueprint on Unreal Engine 4

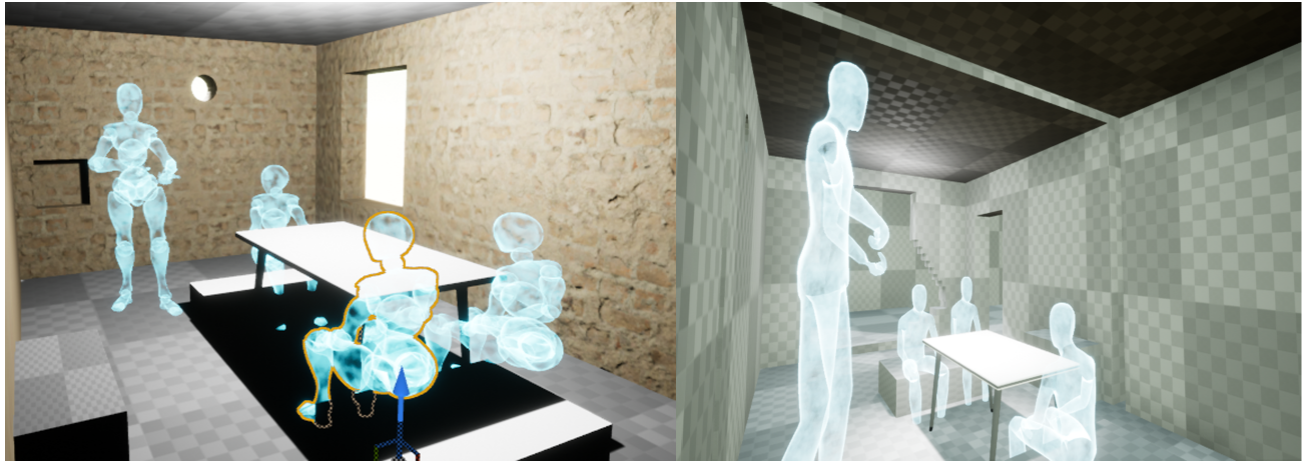


Figure 21: Side-by-side comparison of character models where the left is the initial model and the right is the revised model

Character Models:

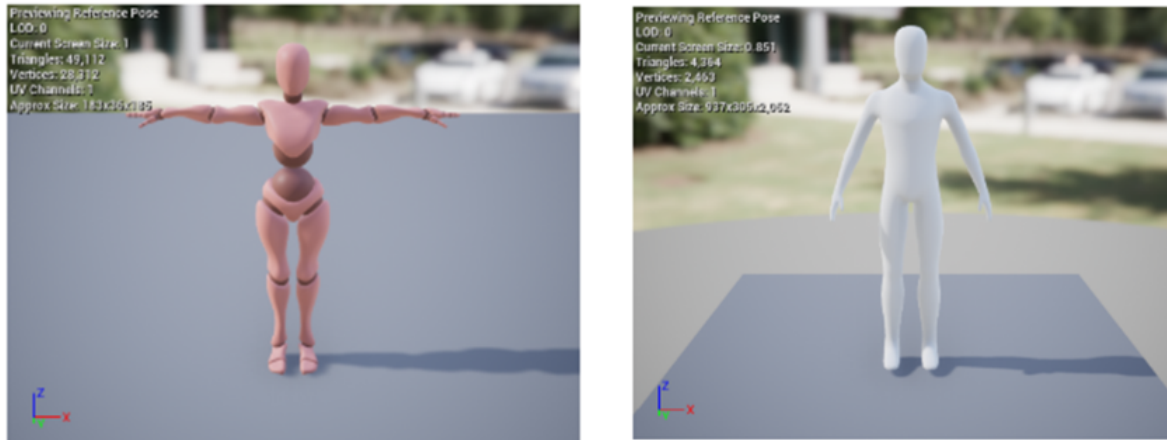


Figure 22: Side-by-side comparison of untextured character models where the left is the Mixamo model and the right is the character model chosen for this project

4.3 Technical

Our application was relatively simple on the technical side of things. There was not a lot of player interactivity designed into the application. Early on, it was our intention to have the application be a visual novel-like game, with players able to choose options that would affect the story. However, we were not able to work these into the story, as our attention ended up being focused on creating our environments and developing our main core story. Without these branching story options, our game wound up being relatively simple on the coding side of things.

Still, there were a few important implementations within the code. We chose to implement these using Unreal Engine blueprints, as they are simple to learn for people unfamiliar with coding and people unfamiliar with Unreal Engine, so whoever next works on the project should be able to continue easily.

The first of these was the camera with a limited range of motion. Unreal Engine has a pre-existing camera object. Putting that into the scene to serve as the user's viewpoint of the environment was an easy first step. After that, we had to code it to rotate by a limited angle upon certain inputs. We ultimately used the W, A, S, and D keys to make the camera rotate. We felt the keyboard controls fit better than the mouse with the limited camera. Although keyboard controls are often not linked to camera movement, mouse controls are usually linked to fully free camera movement. Although we wanted to use the camera to give a feeling of constraint, for people used to games with a lot of freedom and control, we wanted to minimize the frustration they would feel as best as we could while still applying this constraint, and we felt the mouse was better for that than the keyboard. We set them up as axis inputs within the project settings, and then used events to trigger the movement upon the axis input. To limit the range of rotation, we used if-statements to check where the camera was and prevent it from moving further once it reached the rotation limit.

The next technical implementation we made was putting the story within the game. However, the way we chose to do so was arguably unorthodox. In Unreal Engine 4, it is common practice to use widgets to implement 2D UI features. Widgets are a tool in Unreal Engine which can be used to create 2D or 3D elements for the user to interact with. Things like menu screens or dialogue boxes fall into this category. For our story implementation, widgets would have been the common practice for implementing this, but we chose a different option, Unreal Engine's built-in dialogue system. We were more experienced with using this system, so it took us less time and fewer resources to be able to implement it. It also had the added benefit of having the dialogue change on a timer instead of on input. Although widgets can be done using timers instead of input, it is easier to do input on widgets. Similarly, while the dialogue system can use inputs instead of timers, it is easier to use timers on the dialogue system. The dialogue system works by playing an audio file and displaying a caption for the duration of the audio file. Then at the end of that audio file, it moves to another audio file. We used audio files of silence in this system with different captions to have the captions displayed without sound, creating the effect of time-based dialogue. When the string of dialogue that creates the story of an environment finishes, the application automatically switches to the other environment and starts that environment's dialogue system.



Figure 23: Blueprint for dialogue and underneath is what the blueprint produces

An essential part of any application is the menu, which in our case allows users to choose which room they would like to see. To create a simple menu, we used widgets to create buttons which would take users to the currently implemented rooms. Using widgets for this allowed us to create a simple menu which would appear in its own level, and which would then disappear when the user clicked any part of the menu that would bring them to a different room or level. This also has the benefit of being extremely easy to customize and expand upon in future iterations of this project.

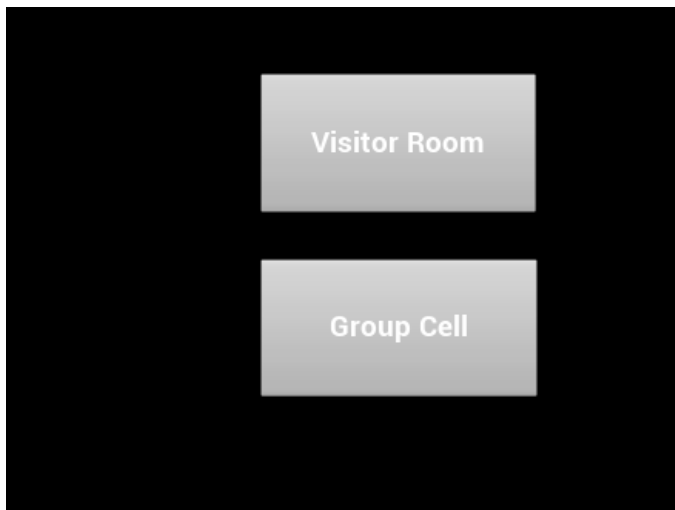


Figure 24: Simple main menu

5.0 Methodology

When developing this application, user testing was an important focus for us to consider. Some of our technical aspects—such as the automatic text and the fixed camera motion—were implemented to create a specific effect for the users. We wanted to understand how well we were completing our overall goals in terms of eliciting feelings of hopelessness or helplessness and in making the application interesting and attention-grabbing. Due to the struggles we had on the artistic side of the development process, user input on the overall quality of what we created was necessary to gauge where the current application was in terms of usability and interest. To get information on all these things, it was important for us to do user testing.

5.1 Survey

To do our user testing, we decided on using a survey. The biggest reason for us to use a survey was its ease of administration. Surveys are one of the easiest data collection methods for reaching a larger audience of people in a shorter time frame. This is because it does not involve the user directly interacting with one of the people collecting the data, so more users can participate at one time. We particularly chose to administer our survey online. We sent out emails and Discord messages (messages on a server of WPI Interactive Media and Game Design (IMGD) students on a social media/chat app) offering an opportunity to participate in the testing, and then we sent the application, instructions, and survey to those who chose to participate. This allowed these people to complete the survey at whatever times were best for them. This meant more people could find time to participate, so we got more responses and a larger data set to work with.

Our survey had several sections, each with different goals in mind. The first two sections focused largely on the group cell room. These aimed to determine how well this environment captured our desired atmosphere and tone and how recognizable the environment was. The next two sections focused on the visitor room and aimed to gain the same type of information as the group cell room. Our fifth section focused on the story we were telling. We aimed to determine how effective the story was in holding the user's interest and conveying our desired tone. We also looked to understand how effective the way in which we told the story was and how to improve it for the future. The sixth section was aimed at determining how intuitive the app was to use from a user perspective. The final section held demographic questions, as we were administering the survey to multiple groups of people who might have differing perspectives on different parts of the application. The survey we used can be found in Appendix C.

This survey was made into a Google Form that could be sent out to everybody who participated in the testing. There were a few different groups who we asked to participate in the user testing for this application. The first group consisted of WPI IMGD students. These people

would be the easiest for us to reach, and the most incentivized to help us due to the WPI IMGD department's policy of requiring students to playtest twice during any IMGD class they take. They would also have the best understanding on the overall quality of our work. These students often have experience working with the technology we were using to develop our application, and many have developed virtual environments themselves. As such, they were likely to have the most critical eye when it came to how well we created our environments and pointing out areas of improvement. The second group consisted of Albanians. This application is a digital recreation of a part of their history, and will likely be most used within Albania in the future. As such, we felt it was important to get an understanding from them on how well we conveyed our desired tone and captured their attention. We had two groups we reached out to for this. The first was a list of Albanian students that our sponsor, Cultural Heritage without Borders, sent us. The second was a list of recommendations by Aleksander Proko, an Albanian WPI student looking to create an Albanian Student Association at WPI.

5.2 User Testing

When we released our first invitations for user testing to our targeted group, we only included a general idea of what our product was, what the testing was, and the consent form that testers were required to fill out. This way, we could ensure that everybody who participated in the playtesting had read and agreed to the consent form. We asked volunteers to fill out and email us the form. When we received a filled-out consent form, we in turn emailed that volunteer a link to a Google Drive folder that contained the packaged game and the instructions as well as the Google Form itself. The packaged game was a zip folder that contained a built and packaged executable of our Unreal project. It started off by taking them to the menu screen to choose between the two environments. They could then choose an environment, go through that environment's story, and then be taken to the next environment. Our testing instructions, located in Appendix G, included steps on how to download and navigate the application, how to use the camera with a limited range of motion, when the application's story ended, and how to exit the application after it ended. It also contained an additional link to the Google Form. The Google Form was the actual survey itself. We sent our first requests for volunteers out on February 15th, 2022, and closed the testing on March 14th, 2022. During this time period, we got 17 survey results.

6.0 Results

When reviewing the qualitative questions regarding the Group Cell Room from the non-Albanian cohort, people unanimously stated there should be more assets—such as human models and beds—in the room to better encapsulate the feeling of confinement. To make the Group Cell Room more distinguishable, people suggested adding bars on both the doors and windows. This was a good idea for us, but also contradictory to the idea of trying to show people how the prison has been stripped bare by looters and time. People also wanted the bed frame to be textured with rust to better incorporate the feeling of hopelessness in the room. To address the feedback while not compromising the initial intent, one idea we had was to add more human models and beds in the room. To keep the echoes of the past theme, these assets could be given the same spectral texturing that we used on the ghostly human models. To address the rust texturing for the bed frame, we considered adding it for one bed to better portray the current run-down state of the Spaç Prison. When reviewing the qualitative questions regarding the Visitation Room from the non-Albanian cohort, the main concern people pointed out was the missing fence to identify that this room is the Visitation Room, and this is something we would want implemented in the next iteration of the project. People also pointed out rendering issues that were present in the Visitation Room, such as an orb emerging from the floor of the room and distortion in the right arm of the Spaç Prison guard. The team immediately took this rendering issue into account and re-rendered both the Visitation room and the Spaç Prison guard model. Although it did not work immediately, we discovered that the engine was rendering a sphere around the (0, 0, 0) coordinate in the world, so we just had to move everything up to avoid this coordinate. After that, we did a final render so we could have the packaged project without this orb.

When creating the quantitative questions for user testing, we wanted to assess both the atmosphere and experience for each of the rooms we created for the digital reconstruction. These quantitative questions also helped provide more insights with regards to our qualitative questions, as they show the correlation between the feedback given and the overall rating. We did not create quantitative questions pertaining to the story because the entirety of it is incomplete. We believed such feedback would not be viable enough since the parts of the story presented in the current build of the model are intended to be shown much later on, and an assessment on the story should only be made once it is fully fleshed out, permitting a fair test of the story's cohesiveness as well as its relevance to the Spaç Prison. To assess the atmosphere, we used lighting, texturing, and human/ghost models as a benchmark to determine whether the rooms conveyed the depressing atmosphere we were aiming for. To assess the experience, we used camera movement as a benchmark to determine whether the experience was immersive for the rooms. We then took the average rating out of four for each of the quantitative questions to make our final assessment. We accounted for the average rating as follows: a rating that was three and above indicated that the implementation was effective; a rating that was below three indicated

that the implementation was satisfactory but had some flaws that needed fixing; a rating that was below a two indicated that the implementation was defective and needed to be revised.

	Visitation Room	Group Cell Room
How did the ghosts and the damage to the room contribute to the atmosphere?	2.67 out of 4	3 out of 4
How did the lighting contribute to the atmosphere of the room?	3.07 out of 4	2.8 out of 4
How did the limited control of the camera contribute to the experience?	2.13 out of 4	2.27 out of 4
How realistic do the textures in the room look?	3.27 out of 4	3.13 out of 4

Figure 25: Table that shows the average rating of quantitative questions for user testing. Cells that are highlighted in green indicate that the implementation was effective. Cells that are highlighted in yellow indicate that the area needs more work by future groups.

One key detail revealed by our survey was that our two rooms had different strengths and weaknesses in how they demonstrated their aesthetics. People overall liked the textures and the lights better in the visitation room. Meanwhile, the fixed range camera and the ghosts got higher ratings for the group cell room. Although our survey itself did not help us figure out the reason for these differences directly, looking at some of the answers to the survey questions and our own application together helped to get us a clearer picture of what was going on.

In regards to lighting, the visitor room has a dynamic, flickering light that makes the lighting of the visitor room more interesting and attention-grabbing, while the group cell room’s lighting is constant and unchanging. This is not something that we can just add into the group cell room; the flickering adds to the oppressive air that we want in the visitor room, but does nothing for the depressing atmosphere we try to create in the group cell room. However, looking into other ways that we could add this dynamic element to the group cell room, it could be possible to add a faint dynamic light that moves back and forth outside like some sort of guard patrol, making not just the lighting but the impactful shadows more dynamic as well. The group cell room has another lighting issue: in order to get light throughout the room, we used several point lights, which creates an uneven lighting effect throughout the room coming from nowhere. An idea to fix this would be to remove these point lights and instead try to use ambient lighting from one point light to cover the whole room evenly. The other feature the visitor room has over the group cell room is the texturing. The visitor room has a diverse range of textures—several

textures are on each wall. The group cell, on the other hand, uses only one texture on each wall. This decision was inspired by our source image. The different textures in the visitor room reflect the different levels of decay throughout the room. Meanwhile, the group cell feels more evenly and consistently damaged. Because of the monotony, however, even though the consistency is conveyed, the damage is not so apparent, making the texturing of this room more boring and less impactful than originally intended. This could be fixed by finding and using a more clearly damaged texture or adding more variance to the textures while keeping them similar overall. Another idea is to use the Megascans - Damages by Quixel Megascans. This free asset pack, obtainable on the Unreal Marketplace, contains damages in the form of cracks that can be individually placed.

The group cell room's strengths are its camera and ghosts, when compared to the visitor room. The view in the group cell room, while still limited, feels less restrictive than in the visitor room. One main reason for this is that the group cell has multiple windows the user can see out of, while the visitor room has just a single window that you can barely see the edge of but can not see outside of. This inability to see the far outside world may be frustrating for some players. As the player can not see outside the window in the visitor room, there are no meshes or scenery currently placed on the other side of that window. A future group may be able to change this feeling of confinement into a feeling of isolation by adding an empty mountainous region outside the window with no real civilization in sight, and then adjust the range of camera motion to allow the user to see outside the window. The other strength of the group cell room over the camera room is the room's ghosts. The ghosts are also viewed as better in the group cell room than the visitation room. The ghosts in the group cell room have a slightly larger range of motions and diversity of expressions than the visitation room. The visitation room only has a guard ghost standing watch and three ghosts sitting with the exact same posture and animation. The three ghosts in the group cell room are all very different, as one lays down, one sits, and one stands and sadly kicks the floor. The visitation room may be improved by giving the sitting ghosts postures that differ from one another and that are more expressive.

Our application has a few restrictive features that are designed to help communicate a feeling of confinement and lack of control to the user. These features are the camera that the player can move across a fixed range of motion and the text that advances automatically at a fixed speed, and they were not received as well as we would have liked by our users. While this may be because our features were poorly implemented, we think this is more likely because players were uncomfortable with the sense of confinement and lack of control these features were meant to convey. For example, when it came to the dialogue system, everybody said that they would rather have the dialogue advance with the press of a button, as opposed to advancing automatically, or they wanted the ability to swap between manual and automatic control of the dialogue. However, more than half of the players felt that the speed the dialogue advanced at was good. This indicates to us that it might not be that players have a problem with the implementation of this feature but rather that they just want to have more control. This is against

what we are going for, as we want a player to feel that lack of control. We believe the cameras to be in a similar situation, as in each room they scored a lower average than lighting, textures, and ghosts/models, but nobody seemed to have any specific complaints with them.

As previously mentioned in this report, we asked participants of the survey to grade various aspects of both of the areas created. These aspects included lighting, textures, ghosts and a sense of decay overtime, and the camera. More specifically, we asked how these aspects contributed to the atmosphere or experience. The exception to this is the textures, where we asked how believable they looked in respect to the context of the application. Overall, the higher an aspect averaged, the more it should be focused on by future groups when creating a new area, while the lower the average, the more it should be focused on if future groups decide to refine the current areas. In order from highest to lowest scores, the aspects ranked are textures, lighting, ghosts/damage, and the camera.

7.0 Documentation

Throughout development, we have always known that we would not be the last group of people to work on this project. There is so much more that can be done to further develop this digital reconstruction. There are more areas of the prison that need to be developed, the story needs to be expanded, there are more stories that can be told, and there are features that can be added such as extra languages or player choice within stories. Although the project now exists as an application instead of a website, it still needs to be built for mobile platforms. A huge duty of ours, especially towards the end of the project, has been to make it as easy as possible for future groups to pick up and work on the project, no matter what their knowledge of the project or level of experience using Unreal Engine may be. To do this, we needed to document our code, our file organization, our overall project objectives and goals, how our completed systems worked, the things that still need to be completed, how to go about completing them, and any other ideas or thoughts we had on the project.

The first of our numerous documentation steps was to document our code. In the field of computer science and programming, one of the most notoriously difficult things to do is understand code that was written by other people, especially if you can not talk to those other people in person about the code and how it works. With that in mind, we added comments to all of our code explaining the purpose of each section and how it worked so that future groups could understand it. For our project, all the code we wrote was within the level blueprints. These are areas of code within Unreal that dictate code that affects the entire level instead of just one object within the level. The two features we coded into these blueprints were the dialogue system for each level and the camera controls for each level. Our comments included clarifying what parts of the code were for the dialogue system and which parts were for the camera controls. For the camera sections, we then specified which equations and inputs pertained to moving the camera in which direction. For the dialogue system sections, we clearly outlined a sample of the loop of code used regularly for the dialogue system so that future groups can copy and edit this loop to implement stories of their own, and we added comments at the beginning and end to clarify what started the story and what the code did when the story ended.

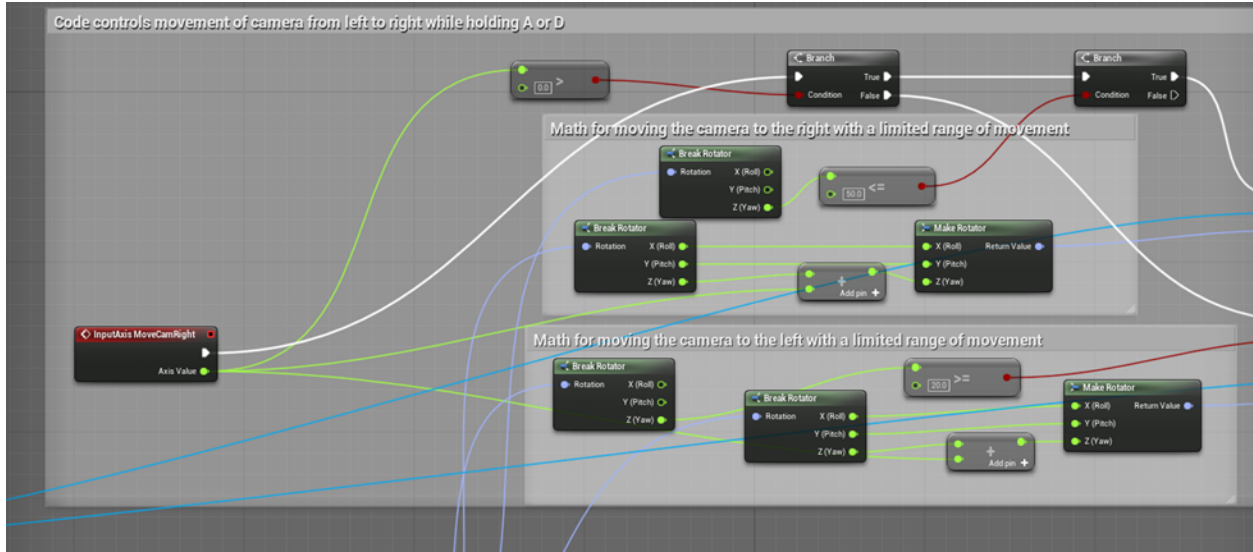


Figure 26: Picture of Unreal Engine In-Code Comments for one of the camera controls

Outside of the comments within the code, everything else was documented on GitHub using Markdown files. These files are denoted with the ending of .md and can be easily navigated around within the GitHub repository website without ever having to touch or download the project itself. We had originally intended to use GitHub Pages, but upon further research found that that would not work for us. In essence, GitHub Pages is a system that uses GitHub accounts or repositories to host websites. Therefore, in order to use this system for our documentation, we would have to create entire websites. While this would be an eye-catching and effective way of holding the information we wanted to communicate, it would also require us to learn new skills in a very short time with no direct benefit to our application. Markdown files for GitHub was a much better method because each GitHub repository is created including a Markdown file called README.md. The text contained in this file is made visible from the repository’s home page (the screen where you download the code), so any important information like instructions on downloading the code or the version of Unreal Engine in use can be seen immediately from the home page. Additionally, Markdown files can contain links to other Markdown files. This allowed us to use the README file as a table of contents to direct future groups to whatever documented information they might need. This means that the documentation would be easily and immediately accessible and navigable even for people who have never seen the repository or project before.

Our README file contains all of the most important information about the project, including the version of Unreal Engine that we used, the project summary, and a guide on how to download and set up the project. This process needs specific instructions, since we have a folder called freeMaterials that contains assets too big for us to store on GitHub. Since this folder is kept on Google Drive, the process of downloading and setting up the project is more complicated than if all the assets were on GitHub. In addition, this file contains links to all of the other

Markdown files as well as a description of what information was in each of those files, allowing the README file to serve as the central hub of the documentation.

Our Markdown documentation also includes several step-by-step guides on how to do various aspects of the project. Our EnvironmentCreationGuide.md file contains the general process of how to go about creating an environment. Although it lacks specific instructions since each environment is different, it will help bring up to speed those who are new to creating 3D environments using game engines like Unreal Engine or Unity. The DialogueSystemGuide.md file contains step by step instructions on how to use Unreal Engine's built in dialogue system to implement any future stories or scenes that future groups may write. The WidgetGuide.md file contains the basics on how to use widgets to create menus or UI elements. Although this will not be very useful to experienced Unreal Engine users, it will be useful to new users, so we included it because we do not know the level of Unreal Engine experience in future groups. Finally, we have the CHAR_ANIM.md file, which explains in detail how to obtain humanoid models and animations for them from online sources and how to implement them within Unreal Engine. This guide was included as these assets were some of the more complicated to acquire and less intuitive to implement, especially for those who have never done so before.

We have two files explaining the file structure of the project. The first of these is our Organization.md file. This file explains how the Unreal Project is organized and which files contain which assets or levels. This was included so that future groups can know how to find the assets they need and how to continue using this organizational structure when they add their own assets. We also have a MaterialCredits.md file. This file documents all of our third party assets, where they came from, and who created them. This provides the credits for our third party assets and lets future groups know where they can find similar assets to the ones we used. It can also help if they, for any reason, have problems with getting and importing the freeMaterials folder that contains most of our third party assets, in which case they may have to manually re-import each asset.

We have several other useful files with general information or information on how the application can be expanded upon in the future. Our MOODBOARD.md file contains information on the sources we drew information from and the overall mood and tone we wanted to convey with the environments we developed. This will help future groups match the mood and tone we tried to make so that the application can continue to feel as cohesive as possible. The Pitfalls.md file contains information on our past mistakes that slowed our progress down so that future groups can avoid those mistakes and work as efficiently as possible. Our FutureFeatures.md file contains any plans or ideas for future features that can be implemented such as extra languages or a pause menu. Meanwhile our NS.md file contains the immediate next steps that should be taken by the group immediately following ours.

8.0 Recommendations and Conclusions

8.1 What Went Right

User testing was conducted to determine which aspects of the project worked as intended and which needed improvement. The results showed an overall positive response to the environment and story and indicated other features were also achieving their intended purpose.

While the team relied on textures acquired from the Unreal Marketplace to create the environment, these textures were able to create an immersive environment. User feedback showed the textures were found to be realistic and did not break the immersion or otherwise stand out enough to ruin the experience. The same was said about most of the ghostly human models used to represent characters in the story. Their appearance made it clear they were not actually physically present, and their roles in the story were conveyed well enough that users were able to connect each figure to who they represented in the story in the visitation room. The design was clear enough that each room's purpose was correctly identified by a majority of users as well.

The systems the user interacted with had no major issues. Most users reported that the story's dialogue was easily readable and proceeded at an appropriate pace. While some users did struggle to follow the plot of the story, the dialogue system used to implement it did not seem to be the cause of this. Although many disliked the dialogue system, it seemed like they took issue more with having a system that intentionally took control away from the player and less with the implementation of that system. The controls were found by most users to be intuitive and easy to use. The lighting additionally allowed the users to clearly see what was happening in each room, while also contributing to the atmosphere of the setting.

8.2 What Went Wrong

Throughout our project, we encountered several obstacles. The first major challenge was adjusting to working in Unreal Engine. Although one of us was familiar with the program, overall, our team lacked experience, and we underestimated the amount of time and effort it would take to reach the level of proficiency necessary for creating a digital recreation. Another issue with adjusting to working in Unreal was editing meshes. Our original plan for the visitor room involved a fence mentioned by former prisoners which would separate the prisoners from their visiting family members. We intended for this fence to be damaged, as it is no longer present in the actual prison and we want to show it was damaged over time, but we were unable to find a suitable asset for this. We found that we were unsure how to modify an existing mesh we obtained from the Unreal Marketplace to suit our needs. This lack of familiarity forced us to spend time learning how to use the engine and investigating the best ways to implement different parts of the recreation.

Technical problems were encountered when managing the project on GitHub. The team was unable to upload all the files necessary for textures due to issues with GitHub Large File Storage (LFS), as we did not have enough storage room. We had to get around this by storing our textures in a folder that GitHub ignored and then uploading that folder separately on a Google Drive for everybody to access and download. Additionally, merging branches to combine changes made by different members of the team often resulted in changes being reverted or confusion regarding the correct version of files. This was not a significant issue for our team, but in future iterations, as the project grows in size and complexity, this will pose a much greater challenge if not addressed early on.

Another major issue that slowed down progress was miscommunication. Early on, as the team was still learning how to work together and use Unreal Engine, it was not always clear who was working on getting each of the assets we needed for our environments. This resulted in lost time as everyone believed someone else was handling a certain asset, and was mostly resolved when we created an asset list. One necessary step in the development of this project—the need for IRB approval before conducting user testing—was severely delayed due to the team being unaware we needed that approval until we were about to begin testing. Other delays occurred as a result of team members being left out of email communications or being unable to contact each other when problems prevented team members from attending meetings. While these issues became less common as time went on and the team adjusted to working together, they nonetheless impacted when work was completed and how fast it was completed.

8.3 Recommendations

Based on the results of the user testing we conducted, and our experiences developing this digital recreation, we have come up with recommendations for future groups to continue working on this project. As we discussed earlier, the feedback provided by the user testing revealed a variety of issues which many users believed needed to be improved upon. While some of these issues were minor and easily fixed, others indicate the need for additional features.

We recommend future teams consider adding accessibility features to the application. The main goal of this recreation is to raise awareness of Albania's past and the state of the Spaç Prison among younger generations. Adding features to make the application easier to use will help with this. Some users said that the chosen font made the text difficult to read, and one user said the color was difficult to read against the background. Future groups should consider finding a way to make the text stand out more from the background and also consider adding options to adjust the text size and change the font. Previous iterations of the project also had the option to switch between English and Albanian, which is not present in the current version of the project. We highly recommend future teams work with CHwB to add an Albanian translation.

Another issue reported by many users was difficulty following the story. We believe this was mostly due to the fact that the planned introductory scene is not present in the current

version. Without an introduction, users are thrown into an unfamiliar environment with no prior knowledge, and are left to figure everything out based on context clues. Future teams looking to improve on the existing story should start by adding an introduction, as this will significantly improve users' understanding of the rest of the story. Extra care should be given to writing the introductions of any additional stories that are added later on to avoid this issue.

It is also recommended that the ghosts used to create the Echoes of the Past effect continue to be developed. Users noted that it could be somewhat difficult to connect each ghost in the visitation room to who they were in the story. This could be addressed by adding more detail to their models or simply adjusting their animations to make them each unique and more expressive. We also recommend adding many more ghosts to the group cell room. Currently there are just three figures present, but the room is described in the story as having been cramped and as having housed as many as fifty people. This is not reflected by the current appearance of the room, and adding more figures is one way to address this. Additional assets, such as more beds, should also be added to the group cell room.

In order to successfully implement these features, we recommend future groups focus on clearly dividing up work and setting strict deadlines. If one member of the team has trouble completing a task, they need to communicate this and ask for help or ask another member of the team to complete the task for them. Teams need to be careful that in doing this, they still complete the task by the planned deadline. When a feature is found to be more challenging to implement than expected and begins to get passed between group members with each trying to solve the issues with implementing it, it can become unclear who is in charge of the feature and when it will be completed. This can result in miscommunication that wastes time and delays other features being added to the recreation. Effectively working together requires team members to coordinate with each other, and we strongly recommend taking time early on to ensure this is possible.

8.4 Final Project Visions

As we continue to look towards the future, it is important to outline the ideas and visions we had for what this completed application would be like. As with many iterative projects, this is subject to change if future groups who participate in this project have other ideas or are given other goals for the project. The ideas that we had while working on this project are a good starting point for future groups to have when they are determining what work still needs to be done.

The most clearly established aspects of our visions for the future are the things that we had to cut out when downscaling our current project. This means everything pertaining to the main storyline that we had originally wanted to tell. This storyline was referred to earlier in our report and takes place across two days and five locations within the Spaç Prison. Certain environments would have multiple scenes to them. The mines would have had one scene on day

one and one scene on day two. The roll call platform would have had two scenes on day one and two scenes on day two. The group cell room would have had two scenes on day one and one scene on day two. These repeat scenes for the area would not necessarily have been too interesting, nor would they have provided new information. They would have hammered home how consistently harsh the environment was, how unrelenting the regime and prison was, and how little they had to look forward to on a day to day basis.

Not only did the story go uncompleted, but so did the set of five environments. In a completed version of the app, the group cell room, the visitor room, the isolation cell room, the roll call platform, and the interior of the mines should all be completed. Of these, only the group cell room and the visitor room are currently completed, and even the visitor room could still be improved further. Of particular note is a missing chain-link fence that is cut around the table. The remaining environments have completed greyboxing, but nothing else. In addition to these environments, there are further locations within the Spaç Prison that could be added to this story, even though they were not in the original plans. One such example is the crowded bathrooms in which the prisoners showered in the mornings, which could be used for social situations and adding tension due to how crowded the bathrooms could be.

The team envisions this project as having the story branch out where the user will be given choices throughout the course of exploring the digital reconstruction model. This interaction allows the user to be more immersed in the model where they are making choices as a Spaç prisoner. Though events vary based on the choices a user makes, the ending will always result in a sense of hopelessness, for which the choices made did not amount to anything. To make the digital reconstruction model much more dynamic and captivating, incorporating alternative stories will give perspective for users experiencing the model firsthand. For instance, one idea is a story about life as a Spaç Prison guard and a story detailing the Spaç Prison revolt that occurred. These may require an entirely new set of researched topics and first-person accounts. Implementing multiple languages in the digital reconstruction model will help to connect a larger audience as they will better understand the significance of the Spaç Prison, and this comprehension will provide an immersive experience.

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Appendices

Appendix A: Visitation Room Script

In spite of spending eight hours in the mines, I couldn't tell if the temperature had changed at all. In fact, if anything, it felt even colder in contrast to the heat of the mines. The long sleeves didn't help with the winter air at all. I may as well have been naked for all the protection they provided. My fingers tingled and my face stung all the way to the family visitation room.

I breathed outwards in relief when I finally got inside as I took stock of the room. It wasn't warm per say, in fact it could be said that the room even felt unwelcoming, being split down the middle by the fence, but it was still warmer than being completely exposed outside. I walked over to the table, pulled out the chair and sat down.

Turning to the guard, I considered asking if he was going to go get my parents, who had come to visit me today, but I decided not to speak up. They probably had somebody else bringing them, and there was no way that me essentially asking the guard to leave would be taken well. So I turned back towards the fence and the other end of the room.

Soon I heard very muffled voices from the other side of the room. I couldn't really make out any of what they were saying though. And after another few seconds, the door opened and my parents walked in.

"Arjeta!" My mom cried out, smiling with tears in her eyes as she saw my disheveled state and dirtied face from working in the copper mines all day. She took a hurried step forward before her eyes shifted off towards my left side and she slowed her pace considerably. Dad walked behind her in measured steps.

"Mom! Dad!" I called back, hurriedly standing up myself. In my haste, I knocked my chair back, tipping it slightly but not knocking it over. Out of the corner of my eye, the guard gave me a warning look, but didn't say anything, and so I also hurried over to the center of the room, to the left of the table.

"Arjeta, I missed you!" My mom repeated as we met in the middle. The chain link fence blocked us from hugging, and tears almost welled up in my eyes as a sudden feeling of regret that I couldn't embrace her washed over me. But I blinked them away and was at least able to touch her fingers through the fence.

"I missed you too Mom," I said, as I tried to push my hands against the fence as hard as I could to feel her warmth as best I could. The fence rattled though, and the guard now behind me cleared his throat loudly, so my mother and I quickly retracted her hands.

Mom walked over to the chair on the other side of the fence as my dad walked up to me, and soon we touched fingers through the fence as well. After a moment of silence, my dad spoke up.

“Arjeta, hope you’re hanging in there,” He greeted. It was much more calm than my mom’s greeting, but I still felt grateful for the worry in his voice.

“I’m doing as best I can,” I responded. He frowned, perhaps a little concerned that I didn’t respond better, but he smiled softly a second later as he retracted his own hands and nodded over towards my chair.

“We brought up some food for you,” He announced as I pulled my chair back up to the table and sat down.

“Thanks! I’ll make sure to enjoy it thoroughly,” I responded. It really was good for me that they were able to bring up food for me. Although it tends to get torn apart as its inspected by the guards, and I doubt they were able to bring up anything special like meat or fresh fruits or vegetables, it’ll still be food, and it’s always good to be able to get more.

My mom elaborated further on Dad’s statement. “It’s mostly just some grains. We brought you a few rolls of bread and some pasta. It’s plain, so it’s not your favorite, but…” She glanced at the guard. She was probably worried about overstepping her bounds and saying something criticizing or negative about the way the prison did things, so I stepped in.

Smiling at her, I told her “I’m sure it’ll be the best pasta I’ve ever had.” Then I focused my attention towards Dad, who slouched tiredly behind Mom, still wearily glancing at the guard every so often.

“You look rather tired Dad. Are you getting enough sleep?”

He stood a little straighter. “It’s been a little rough the past couple months. I came down with a fever a few months ago and had to take a break from work. So I’ve been working extra hard recently to catch back up.” He glanced back over at the guard again. “It’s my duty as a citizen of Albania.” The guard acknowledged Dad’s statement with a nod.

“I’m glad to hear you’re better. Were the rest of the family unable to help you out?”

“They have their own roles in society. But your cousins have been doing well! Leonora actually finished her schooling within the past year, and she’s looking for a job now. And Kreshnik got a promotion!”

I gave a smile. It was nice to hear they’d been doing well. I wondered if I’d have been able to get a promotion recently if I hadn’t been imprisoned. Or if I’d have been able to help

lighten some of the burdens Dad had to carry when he got sick. It made my heart hurt a little, but I made sure the smile never slipped. “Can you congratulate them for me the next time you see them?”

“Absolutely” Mom said. “I’m sure they’ll be happy to hear it.”

“And Jetmir?” I asked. “He’s not getting himself into any trouble?”

“Your brother’s doing fine. Not only is he making enough to provide for himself, he’s making some new friends who are well off too. There’s one of them, a nice young man named-”

BANG! The table shook as the guard slammed his hand down next to where I sat. My parents, even from the other side of the fence, flinched backwards.

“Prisoner visitations are STRICTLY for family and about family, ONLY,” He asserted. My parents hastily nodded and apologized to him until he removed his hand and returned off to the side.

The conversation slowed down after that. We tried to stay on topic about family, but on more than one occasion the discussion experienced long pauses as my parents nervously glanced at the guard, seemingly unsure of what to say. And as each second passed by during those pauses, I was acutely aware that it would be a long time before my parents would be able to visit again, and that we were here for a very limited amount of time.

And after what felt like a far too short amount of time, the guard spoke up again. “9 Minutes are up. You have 1 minute left.”

Smiling softly as tears started welling up in Mom’s eyes, I walked up to the fence. My dad was the first to join me this time around, and we touched fingers again.

“I know you’ve been having a rough time of it here,” He started. “But stay strong son. Stay strong.”

“Thanks dad,” I answered. “You too. Mom’s counting on you.” He nodded, and I nodded, and then he let go so mom could take his place.

“Arjeta,” She started, tears in her eyes still. Her voice was soft and almost cracking. “Please, Please. Stay safe. Whatever you have to do in here, in this place. Whatever it takes to live. Please, just...stay safe.”

As we let go, she suddenly broke into sobs. Her knees buckled and she collapsed into Dad’s side as he stepped forward to catch her. Tears started to well up in my own eyes.

“Time’s up,” the guard said. He stepped forward and tightly squeezed my shoulder. I buckled and let out a hiss of air, but nothing more as he forcibly turned me to the door.

“Get moving,” He ordered.

Resisting the command from a guard was pointless, and so I obediently followed, staying strong and moving forward. But as I heard continual cries of “Stay safe!” between the sobs of my mother behind me, a couple of tears began to flow as I stepped out into the biting cold, freezing on my cheeks and leaving an empty and cold feeling in my heart that was sure to stay for the days to come.

Appendix B: Group Cell Room Script

I was exhausted when I finally entered the sleeping room. It wasn't exactly a new thing for me. Ever since I first arrived here, the work in the mines had been brutal. But it wasn't really a thing that ever got better, or that you ever got used to. It still drove the way I immediately went over to my bed to lie down.

Getting over to my bed was a task in and of itself. My bed was towards the back of the room, so I had to squeeze by other beds and people to get over there. It might've been impossible to make it all the way to the back if I wasn't as thin and starved as I was. No matter how careful I was, I always bumped into a few people on the way. They didn't get mad though. They didn't have the energy to do so.

Once at my bed, I immediately laid down. There was no room for me to sit, no space for me to stand. I couldn't even lay flat, and instead had to lay on my side. So I laid down, facing a prisoner in a neighboring bed, and began talking.

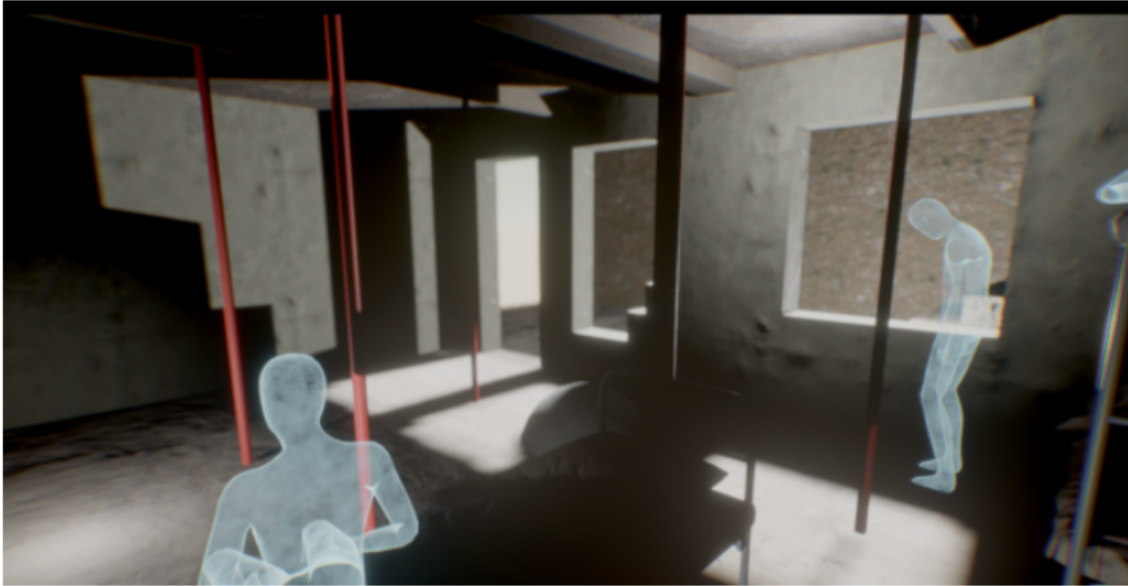
The time before curfew was one of the few times I had to talk to people. To know I wasn't alone in my suffering. But we didn't have long. Curfew was soon, and once lights were out, not a noise was to come out of the room. I hadn't seen or heard this rule disobeyed since I had gotten here. And I didn't really want to know what the punishment for breaking it was.

Since before curfew was one of the few times I had to talk, I usually tried to make the most out of it. But not everybody felt the same. The prisoner who bunked above me was usually asleep by the time I entered the room. I didn't blame him for taking that mindset either.

So I talked to my neighbor for a little bit. The conversation was small talk at best. You never say something really important unless it's to somebody you absolutely trust. You never know who'll be selling secrets. But I knew I had a family visitation coming up tomorrow. I would get to see my parents again, even if only for a few minutes.

After a few minutes, a guard came in to shut us up and shut off the lights. In an instant, we were all cast into darkness and silence, with only the sounds of light breathing to accompany us to sleep. It was in this silence I really began to feel how cold it was at this time of year. The room had no heating and the blankets were paper thin. As I reached out behind me, the wall felt as cold as an ice cube. The room's only real saving grace was its torturous lack of space. If it wasn't for the body heat of over 50 people in such a small space, I don't know if it would've been warm enough to live through each night.

Appendix C: Survey



What did you think this room was originally used for? *

- Cafeteria
- Common Room
- Group Cell Room
- Execution Room

This room was a Group Cell, where dozens of prisoners lived together. Is there anything that could be added to the room to help make this clearer? *

Your answer _____

For this room, we were going for a feeling of hopelessness, below are questions asking how effective each feature was to capture this ambience.

How did the ghosts and the damage to the room contribute to the atmosphere? *

	1	2	3	4	
Ineffective	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Effective

How did the lighting contribute to the atmosphere of the room? *

	1	2	3	4	
Ineffective	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Effective

How did the limited control of the camera contribute to the experience? *

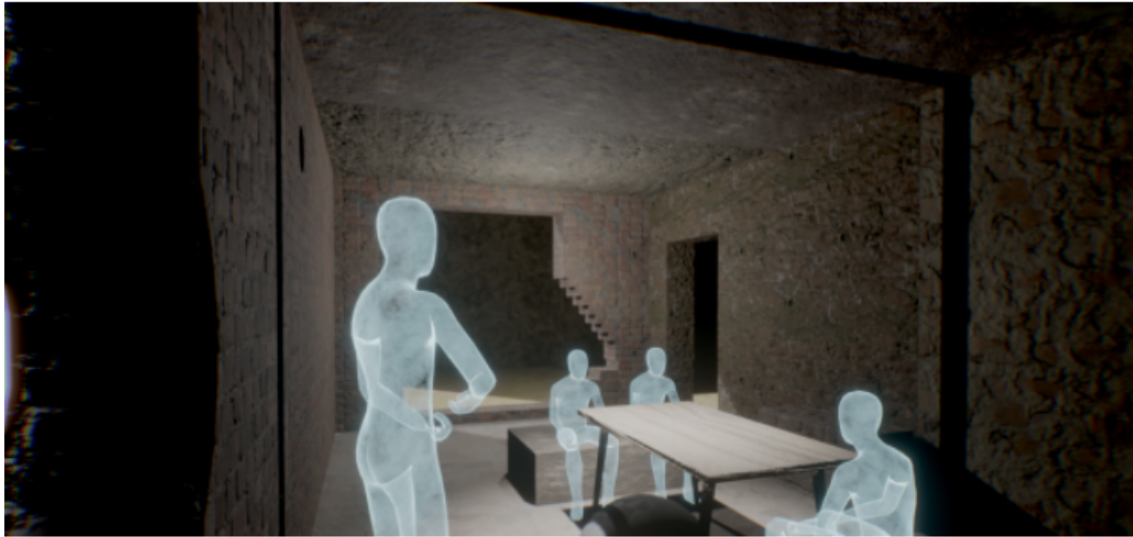
	1	2	3	4	
Ineffective	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Effective

How realistic do the textures in the room look? *

	1	2	3	4	
Ineffective	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Effective

Check which of the following stood out or looked out of place *

- Textures
- Lighting
- Ghosts
- Models
- Other: _____



What did you think this room was originally used for? *

- Cafeteria
- Visitation Room
- Execution Room
- Interrogation Room

This room was the Visitation Room, where prisoners could talk to family members who came to see them. Is there anything that could be added to the room to help make this clearer? *

Your answer

For this room, we were going for a feeling of hopelessness, below are questions asking how effective each feature was to capture this ambience.

How did the ghosts and the damage to the room contribute to the atmosphere? *

	1	2	3	4	
Ineffective	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Effective

How did the lighting contribute to the atmosphere of the room? *

	1	2	3	4	
Ineffective	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Effective

Story Questions

How human do the characters feel? *

	1	2	3	4	
Unnatural	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Real

Did the story being told make you think of another location, event, or time period, real or fictional? If so, what? *

Your answer _____

How well were you able to follow the story? *

- I did not understand what was happening at all
- I was a little confused as to what was going on
- It took me a bit to understand what was going on
- I understood what was happening most of the time
- I clearly understood what was happening at all times

How was the dialogue speed? *

- Too slow
- Just fine
- Too fast

Did you have any issues reading the text? *

- Font size was too small
- Text color made it difficult to read
- The font used was difficult for me to read
- No issues reading the text

General App Questions

How intuitive is the navigation? *

- | | | | | | |
|-----------|-----------------------|-----------------------|-----------------------|-----------------------|---|
| | 1 | 2 | 3 | 4 | |
| Difficult | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Was pretty self-explanatory
and easy |

How do you feel about the dialogue automatically advancing? *

- It's fine as it is
- I'd like the dialogue to advance when I press a button
- I'd like to be able to press a button to toggle auto-advance on/off

Demographic Questions

Are you currently living in Albania, or have you ever lived in Albania? *

- Yes
- No

Do you have Albanian heritage? *

- Yes
- No

Before today, were you aware that Albania had a communist regime in the past? *

- Yes
- No

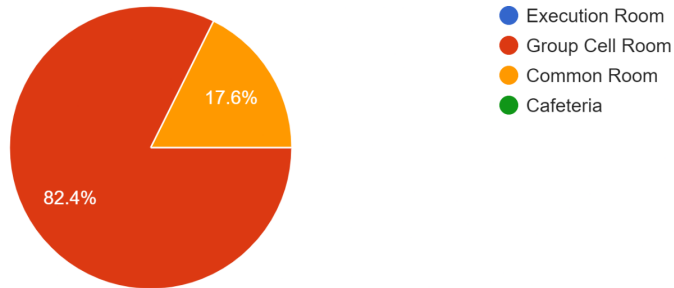
How familiar were you with the Spac Prison in Albania before playing this game? *

- 1 2 3 4 5
- Never heard of it Extremely knowledgeable

Appendix D: Survey Results

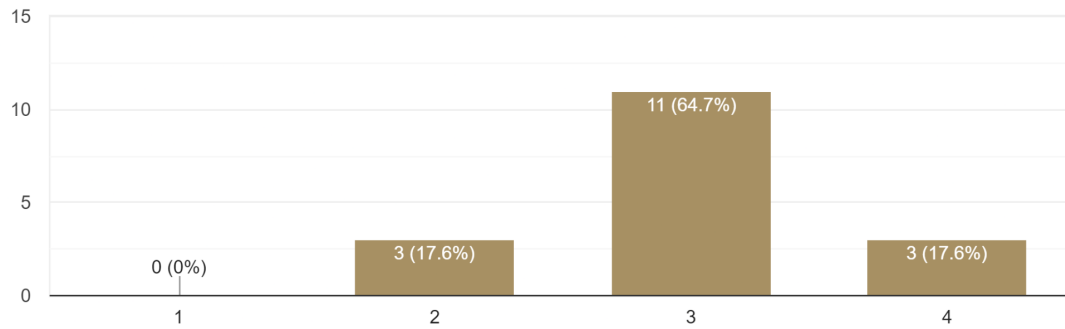
What did you think this room was originally used for?

17 responses



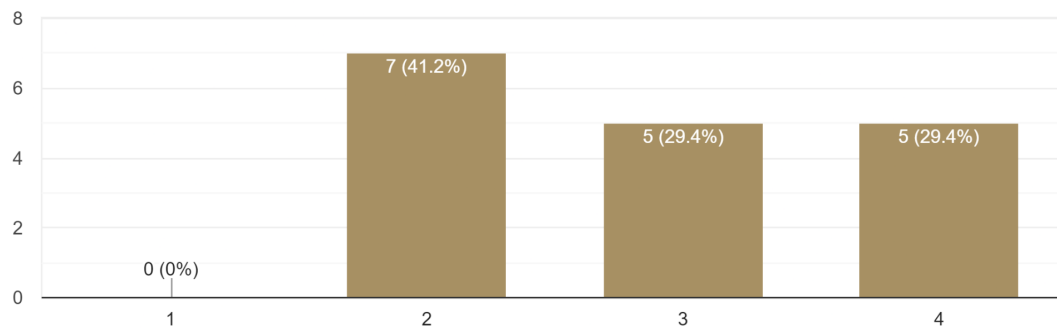
How did the ghosts and the damage to the room contribute to the atmosphere?

17 responses



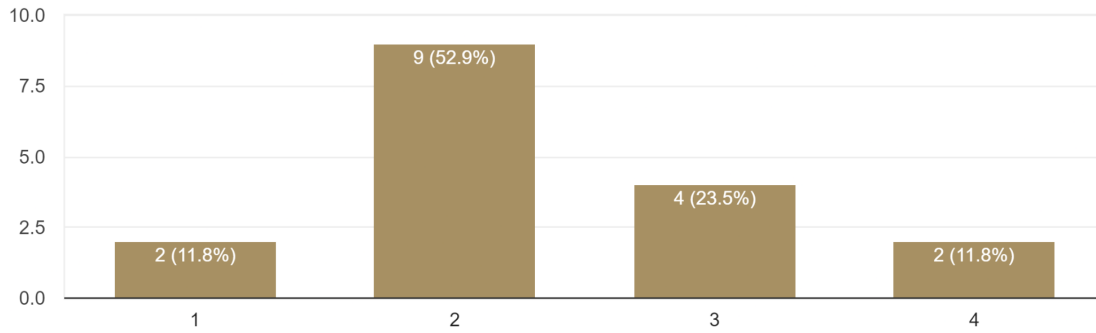
How did the lighting contribute to the atmosphere of the room?

17 responses



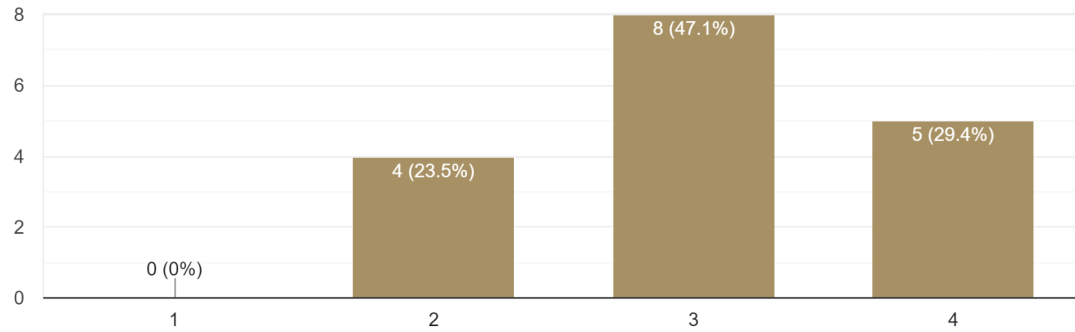
How did the limited control of the camera contribute to the experience?

17 responses



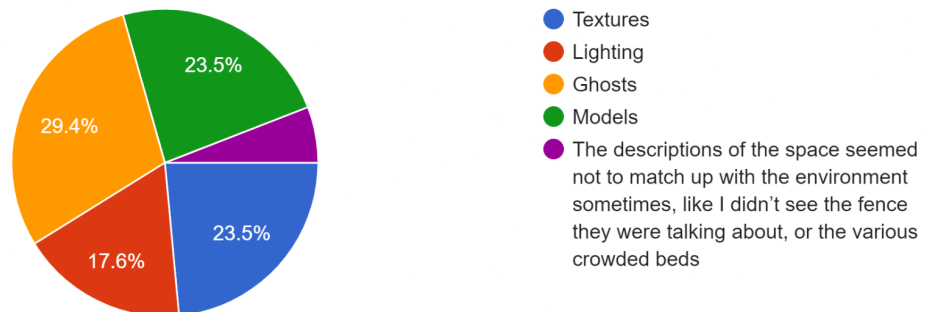
How realistic do the textures in the room look?

17 responses



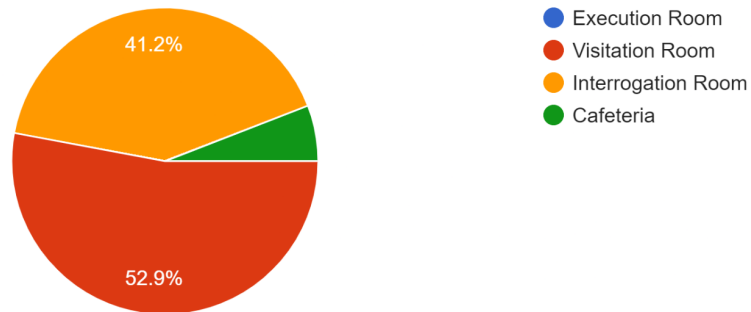
Check which of the following stood out or looked out of place

17 responses



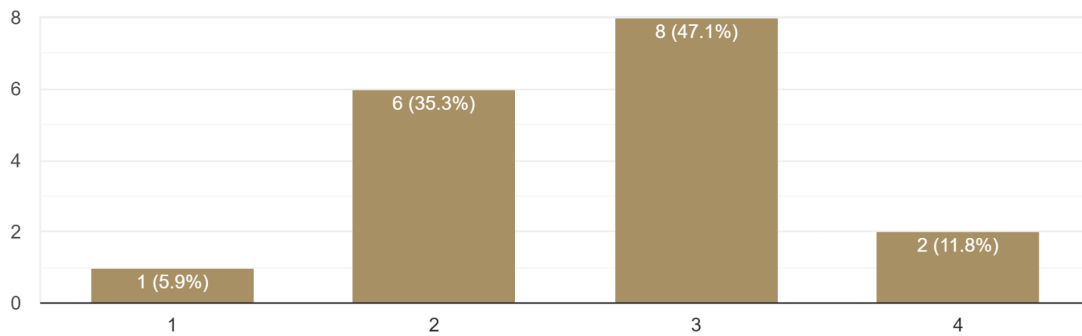
What did you think this room was originally used for?

17 responses



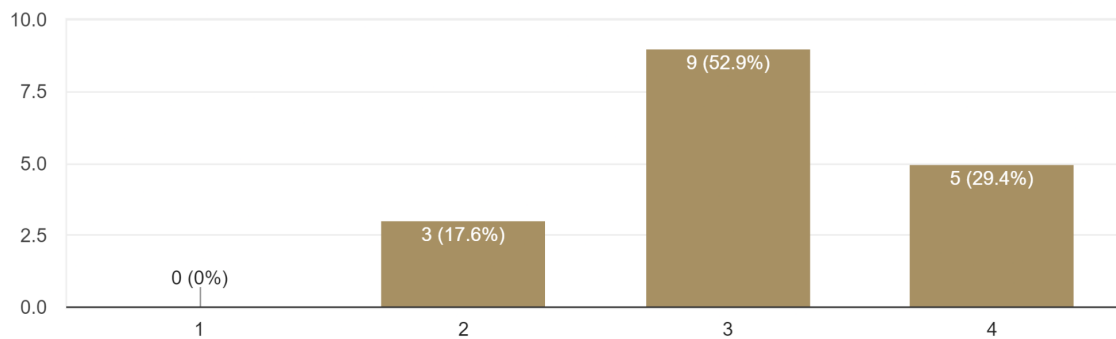
How did the ghosts and the damage to the room contribute to the atmosphere?

17 responses



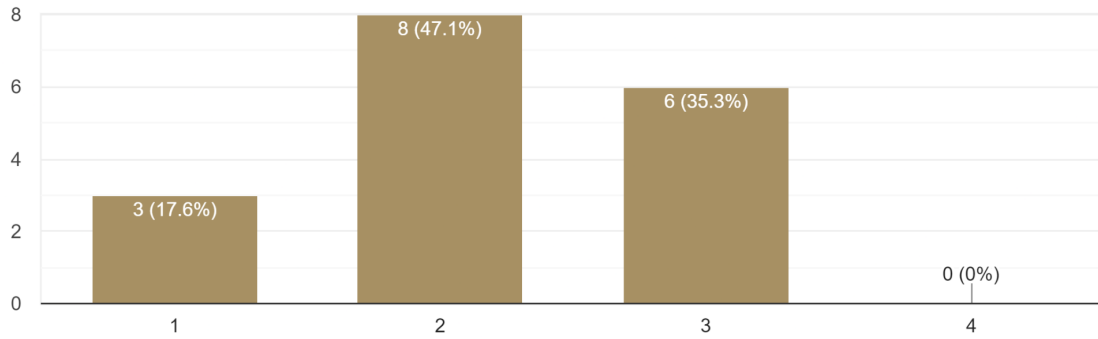
How did the lighting contribute to the atmosphere of the room?

17 responses



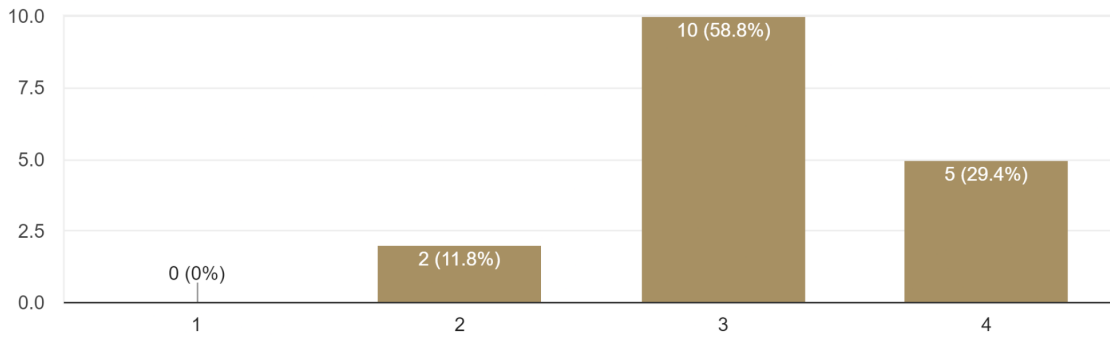
How did the limited control of the camera contribute to the experience?

17 responses



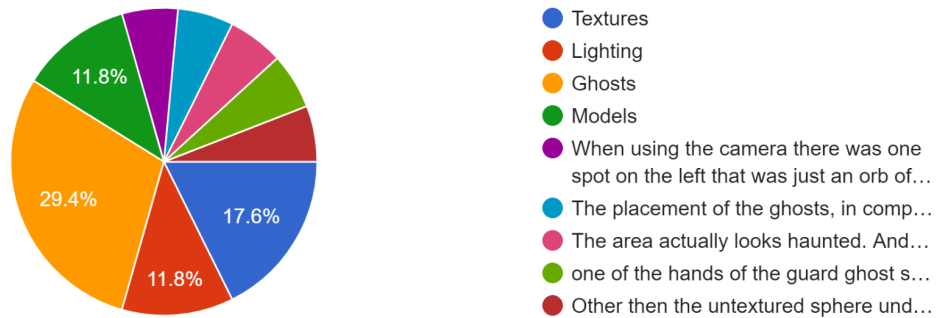
How realistic do the textures in the room look?

17 responses



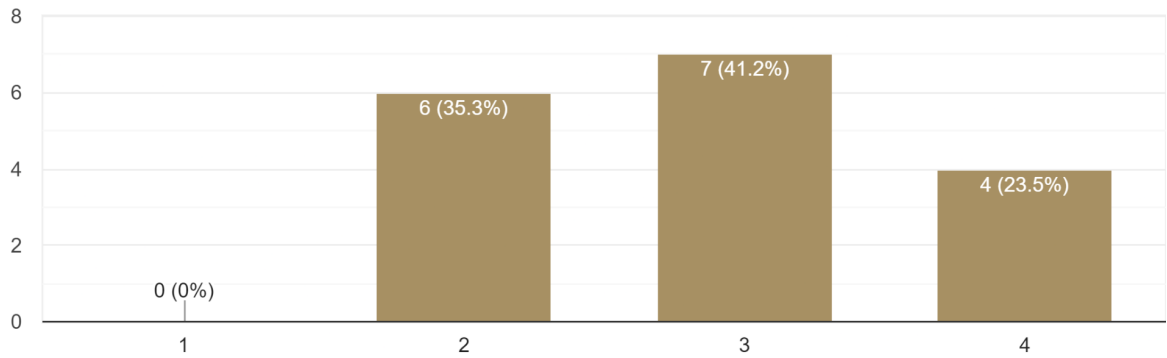
Check which of the following stood out or looked out of place

17 responses



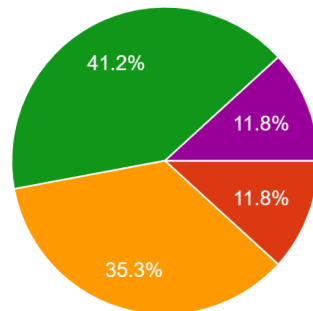
How human do the characters feel?

17 responses



How well were you able to follow the story?

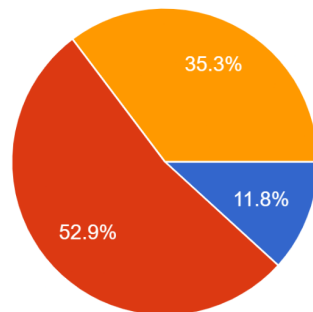
17 responses



- I did not understand what was happening at all
- I was a little confused as to what was going on
- It took me a bit to understand what was going on
- I understood what was happening most of the time
- I clearly understood what was happening at all times

How was the dialogue speed?

17 responses



- Too slow
- Just fine
- Too fast

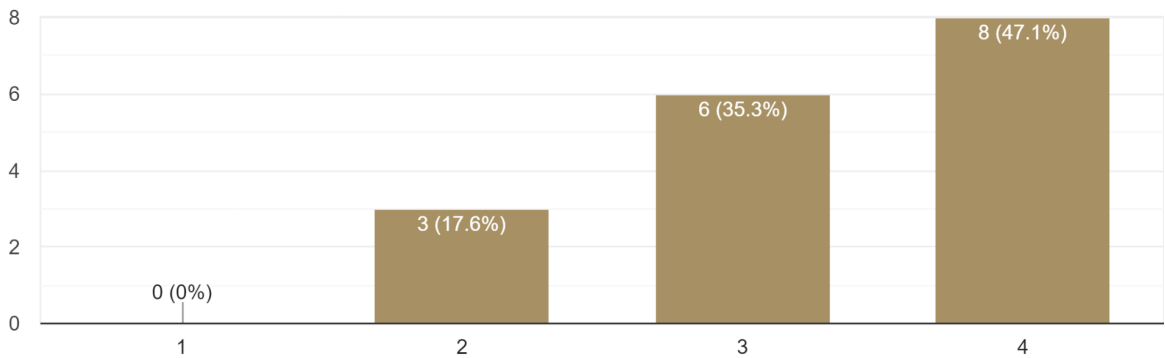
Did you have any issues reading the text?

17 responses



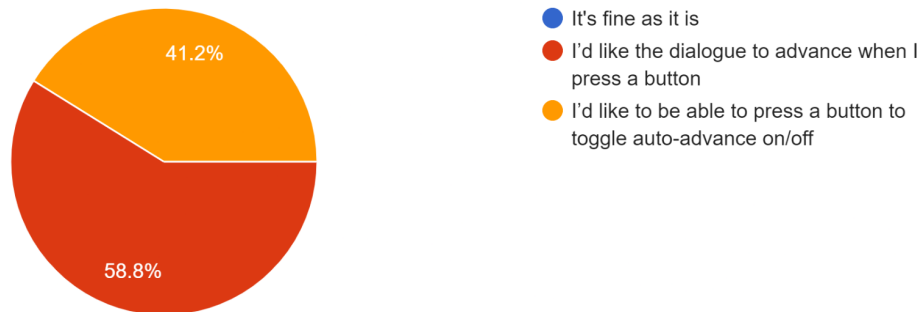
How intuitive is the navigation

17 responses



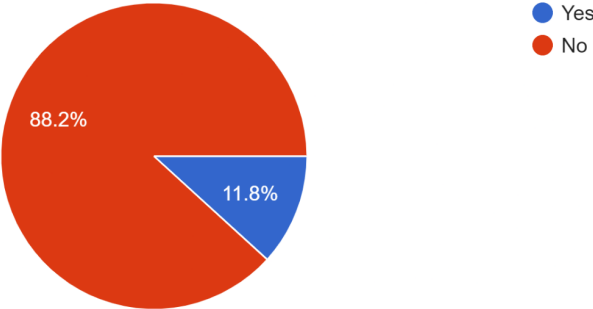
How do you feel about the dialogue automatically advancing?

17 responses



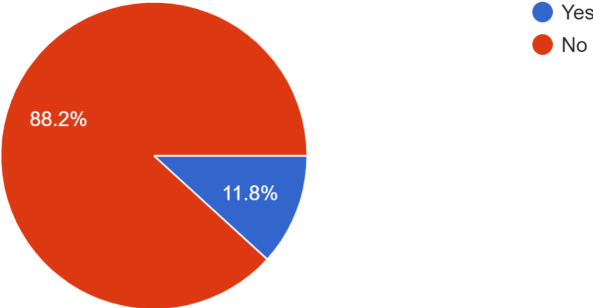
Are you currently living in Albania, or have you ever lived in Albania?

17 responses



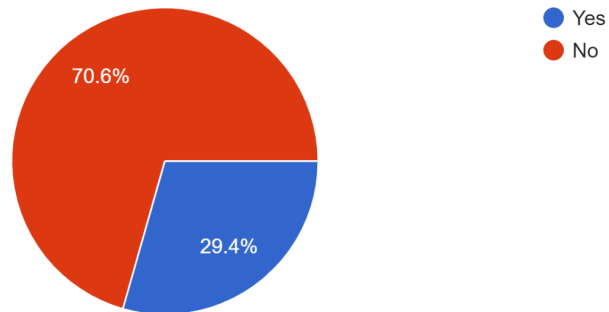
Do you have Albanian heritage?

17 responses



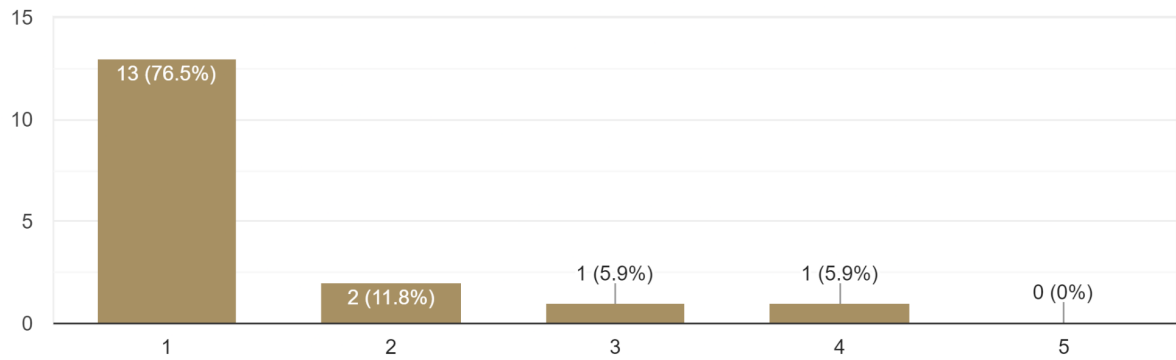
Before today, were you aware that Albania had a communist regime in the past?

17 responses



How familiar were you with the Spac Prison in Albania before playing this game?

17 responses



Appendix E: Informed Consent Document

Informed Consent Agreement for Participation in a Research Study

Investigator: WPI Students

Contact Information: gr-spac-prison-team@wpi.edu

Title of Research Study: Digital Reconstruction Spaç Prison

Sponsor: CHwB (Cultural Heritage Without Borders)

Introduction

You are being asked to participate in a research study. Before you agree, however, you must be fully informed about the purpose of the study, the procedures to be followed, and any benefits, risks or discomfort that you may experience as a result of your participation. This form presents information about the study so that you may make a fully informed decision regarding your participation.

Purpose of the study: This study will help the team get an idea of how immersive and effective the digital reconstruction is for understanding the significance of the Spaç Prison in Albanian history.

Procedures to be followed: Users will navigate and interact with the application for approximately 10-20 minutes, exploring the digital environments and reading the story. The digital environments each consist of a single room, designed to resemble rooms inside Spaç Prison, which are all in states of serious disrepair. The environments contain pieces of furniture and ghostly figures which represent characters in the story. The user is highly limited in how they can engage with the environment, only being able to control the camera to look around the room they are in, and move between the two available rooms. The story is a fictional series of events based on accounts from former prisoners of Spaç, and plays out for users in a series of text boxes.

Users are given no directions on what to do while exploring the digital environments, though any questions they ask will be answered to ensure they understand what is happening in our application. After they have explored both rooms, the users will be asked to complete a survey to provide feedback on their experience.

Risks to study participants: Potential emotional stress caused by reading a fictional story about a prisoner living in Spaç Prison.

Benefits to research participants and others: None

Record keeping and confidentiality: All records will be stored digitally in a file accessible only to the members of the team. Data shared outside the team will consist of summarizations of all records collected, and responses to individual questions with any

potentially identifying information, such as demographics, withheld from individual responses. No records will be reported beyond the responses given to the survey.

WPI students who indicate they would like to receive playtesting credit for participating in testing our application will have their name and email, but not their responses to the survey questions, sent to the WPI IMGD department so they can receive proper credit. The names and email addresses of students who request playtesting credit will not be disclosed in any report, or mentioned in connection with any specific record.

Records of your participation in this study will be held confidential so far as permitted by law. However, the study investigators, the sponsor or its designee and, under certain circumstances, the Worcester Polytechnic Institute Institutional Review Board (WPI IRB) will be able to inspect and have access to confidential data that identify you by name. Any publication or presentation of the data will not identify you.

For more information about this research or about the rights of research participants, or in case of research-related injury, contact: Kevin Dang: Tel. 617 953- 4465, Email: kdang@wpi.edu

IRB Manager (Ruth McKeogh, Tel. 508 831-6699, Email: irb@wpi.edu) and the Human Protection Administrator (Gabriel Johnson, Tel. 508-831-4989, Email: gjohnson@wpi.edu). This section is required.)

Your participation in this research is voluntary. Your refusal to participate will not result in any penalty to you or any loss of benefits to which you may otherwise be entitled. You may decide to stop participating in the research at any time without penalty or loss of other benefits. The project investigators retain the right to cancel or postpone the experimental procedures at any time they see fit.

By signing below, you acknowledge that you have been informed about and consent to be a participant in the study described above. Make sure that your questions are answered to your satisfaction before signing. You are entitled to retain a copy of this consent agreement.

Study Participant Signature

Date: _____

Study Participant Name (Please print)

Signature of Person who explained this study

Date: _____

Appendix F: Third Party Asset List

Forest Landscape Materials Vol.1 by Project Nature on UE4 Marketplace

- fl1_baseGround_I
- fl1_baseGround_II
- fl1_baseGround_III
- fl1_baseGround_IV
- fl1_mossGround_I
- fl1_mossGround_II
- MA_Forest_I_LayerGround
- MI_Forest_I_LayerGround
- fl1_ground_I_albedo_4K
- fl1_ground_I_ao_4K
- fl1_ground_I_normal_4K
- fl1_ground_II_albedo_4K
- fl1_ground_II_ao_4K
- fl1_ground_II_normal_4K
- fl1_ground_III_albedo_4K
- fl1_ground_III_ao_4K
- fl1_ground_III_normal_4K
- fl1_ground_IV_albedo_4K
- fl1_ground_IV_ao_4K
- fl1_ground_IV_normal_4K
- fl1_ground_V_albedo_4K
- fl1_ground_V_ao_4K
- fl1_ground_V_normal_4K
- fl1_ground_VI_albedo_4K
- fl1_ground_VI_ao_4K
- fl1_ground_VI_normal_4K

Megascans – Quarry by Quixel Megascans on UE4 Marketplace

- 010_Sandy_Rock_Assembly_raucM_4K_inst
- Aset_rock_volcanic_S_raucM_4K_Albedo
- Aset_rock_volcanic_S_raucM_4K_Displacement
- Aset_rock_volcanic_S_raucM_4K_Normal_LOD0
- Aset_rock_volcanic_S_raucM_4K_Roughness
- 04_Sharp_Rocks_rbhb7_4K_inst
- Aset_rock_granite_S_rbhb7_4K_Albedo

- Aset_rock_granite_S_rbhb7_4K_Displacement
- Aset_rock_granite_S_rbhb7_4K_Normal_LOD0
- Aset_rock_granite_S_rbhb7_4K_Roughness
- Standard_MasterMaterial

Megascans – Brick Floor Vol.1 by Quixel Megascans on UE4 Marketplace

- 14_Red_Brick_Floor_2x2_M_tf0lac0fw_8K_inst
- tf0lac0fw_8K_Albedo
- tf0lac0fw_8K_Displacement
- tf0lac0fw_8K_Normal
- tf0lac0fw_8K_Roughness
- Standard_MasterMaterial

Megascans – Brick Rough Vol. 1 by Quixel Megascans on UE4 Marketplace

- 011_Rough_Brick_Wall_2x2_M_tetkdjg_8K_inst
- tetkdjg_8K_Albedo
- tetkdjg_8K_Normal
- tetkdjg_8K_Roughness
- 05_Stone_Wall_With_Lichen_2x2_M_thilac3s_8K_inst
- thilac3s_8K_Albedo
- thilac3s_8K_Normal
- thilac3s_8K_Roughness
- 08_Rough_Brick_Wall_2x2_M_te4jeegn_8K_inst
- te4jeegn_8K_Albedo
- te4jeegn_8K_Normal
- te4jeegn_8K_Roughness
- Standard_MasterMaterial

Megascans – Concrete Dirty Vol. 2 by Quixel Megascans on UE4 Marketplace

- 11_Concrete_Floor_2x2_M_ti4nahrcw_8K_inst
- ti4nahrcw_8K_Albedo
- ti4nahrcw_8K_Displacement
- ti4nahrcw_8K_Normal
- ti4nahrcw_8K_Roughness

- 13_Rough_Concrete_Floor_2x2_M_tk4lecig_8K_inst
- tk4lecig_8K_Albedo
- tk4lecig_8K_Displacement
- tk4lecig_8K_Normal
- tk4lecig_8K_Roughness
- 19_Rough_Concrete_rl0lcyp0_4K_inst
- rl0lcyp0_4K_Albedo
- rl0lcyp0_4K_Displacement
- rl0lcyp0_4K_Normal
- rl0lcyp0_4K_Roughness
- 31_Concrete_Smooth_pjtst0_4K_inst
- pjtst_4K_Albedo
- pjtst_4K_Displacement
- pjtst_4K_Normal
- pjtst_4K_Roughness
- 33_Concrete_Smooth_pjtvZ0_4K_inst
- pjtvZ_4K_Albedo
- pjtvZ_4K_Displacement
- pjtvZ_4K_Normal
- pjtvZ_4K_Roughness
- Standard_MasterMaterial

Megascans – Construction Brick Vol. 1 by Quixel Megascans on UE4 Marketplace

- 01_Brick_Ceramic_pbAfv0_8K_inst
- pbAfv_4K_Albedo
- pbAfv_4K_Displacement
- pbAfv_4K_Normal
- pbAfv_4K_Roughness
- 03_Brick_Ceramic_pbAfr0_8K_inst
- pbAfr_4K_Albedo
- pbAfr_4K_Displacement
- pbAfr_4K_Normal
- pbAfr_4K_Roughness
- 06_Construction_Plaster_pb0fdcp0_8K_inst
- pb0fdcp_4K_Albedo
- pb0fdcp_4K_Displacement
- pb0fdcp_4K_Normal
- pb0fdcp_4K_Roughness

- Atlas_MasterMaterial
- BrushDecal_MasterMaterial
- Decal_MasterMaterial
- Imperfection_MasterMaterial
- Standard_MasterMaterial
- Displacement_MasterMaterial
- Foliage_MasterMaterial
- SurfaceBlend_MasterMaterial
- ChannelPackingSample
- noise_mask
- Noise_normal

Megascans: Wooden Planks Vol. 2 by Quixel Megascans on UE4 Marketplace

- tf1medls_8K_Albedo
- tf1medls_8K_Albedo_Mat
- tf1medls_8K_Normal
- tf1medls_8K_Roughness
- Wooden_Planks_2x2_M_07_inst

LPGenericPropsSet10 by MadHoundGames on UE4 Marketplace

- SM_TableSet26

Free Furniture Pack by Next Level 3D on UE4 Marketplace

- SM_Military_Bed
- SM_Military_Bed_2
- M_Military_Bed
- M_Military_Bed_Grid
- M_Military_Bed_Matress
- M_Military_Bed_Matress_With_Blanket
- T_Military_Bed_A
- T_Military_Bed_M_R
- T_Military_Bed_Matress_A
- T_Military_Bed_Matress_N
- T_Military_Bed_Matress_R_AO

- T_Military_Bed_N

Appendix G: User Testing Instructions

Thank you for participating in our testing! If you have not filled out the informed consent form and sent it to us at gr-spac-prison-team@wpi.edu, please do so before following the instructions below. Here are the instructions on what to do:

1-Download and unzip the zip file that contains the Spac prison digital reconstruction.

2-Open up and play the application within the downloaded zip folder. You start on a menu screen where you can choose to experience either one of two environments. You will experience both environments, as once the story of one environment ends, you will automatically go to the next environment. Here are the controls for the game:

Choose an environment by clicking on one of the buttons using the mouse.

Rotate the camera within an environment using the WASD keys.

Exit the application using Alt+F4.

Once you have experienced the full story of both environments, please fill out this google form:

https://docs.google.com/forms/d/e/1FAIpQLSc_SGsOFHO-ldnHU_5gSil0naAYQ03J4pkWgb3yBnD2-4QPyw/viewform?usp=sf_link

If you are a WPI student looking for IMGD playtesting credit, please email us at gr-SPAC-prison@wpi.edu once you have finished filling out the survey in order to receive your playtesting credit.

Once again, thank you for your participation!