ICS2000

Group Assigned Practical Task Report

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May 2023

Access to PowerPoint & Web-Application

In order to access the Group Assigned Practical Task PowerPoint presentation kindly click on the link below, this link will enable you to download the PowerPoint presentation.

Link for PowerPoint:

https://docs.google.com/presentation/d/1GXUFSSnyEsfCfwCvYP1vJeptHvk4mSLK/edit?usp=share_link&ouid=101961941444437937779&rtpof=true&sd=true

The following link will give you the right to download the source code so that you can open the Online Virtual Museum web application.

Link for the web-application:

https://drive.google.com/file/d/1YowYzhTsa3zsuRh-Ax2q7KU9cFTkxFwh/view?usp=share_link

If any problems are encountered or the links are not working, please do not hesitate to email us on the email addresses below:

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GitHub link:

https://github.com/markdingli18/GAPT.git

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1. Introduction

Conventional museums are one of the most-sought after tourist attractions, however in an increasingly digitized world, these seem to lack the ability to adapt. This is not ideal as it results in losing historical and cultural knowledge through time. Digitized and Virtual museums allow users to have easy access to this information and provide a feasible solution to the difficulties and restrictions encountered by traditional museums.

Accessibility is one of the main issues traditional museums face. It might be challenging for people of more rural or remote regions to access museums because they are frequently found in urban centres or other cultural centres. Additionally, typical museums could not be user-friendly for those with mobility concerns or disabilities, which would reduce their potential audience and make it more difficult for them to carry out their educational objective.

Traditional museums also face difficulties because of their reliance on static displays and collections. While these exhibitions can offer a priceless glimpse into history and culture, they can also lose their appeal with time and stop enticing and motivating visitors. Additionally, museums might not be able to display all of their collections due to physical space constraints, which lowers the value of their exhibits.

Finally, traditional museums often encounter problems with sustainability and finance. Many museums rely on public funding or unreliable private donations to keep up with the preservation of its facilities and contents. This may have an effect on the exhibit quality and the museum's capacity to give visitors an entertaining and informative experience.

Despite these difficulties, conventional museums nonetheless play a crucial role in inspiring and teaching visitors all around the world. It will be interesting to see how museums adapt and innovate to meet the shifting requirements and expectations of their audiences as technology and society continue to change.

The aim of this project is to analyze the difficulties that conventional museums face and to demonstrate how digital and virtual museums can offer an achievable solution. The project's goal is to remove barriers like physical limits and geographical constraints by creating an online application that highlights Valletta's museums and their 3D models. This will make it easier for anyone to learn historical and cultural knowledge. The intention is to draw attention to the advantages of digital and virtual museums in terms of accessibility, engagement, and sustainability while simultaneously recognizing the long-lasting value of traditional museums in educating and motivating people from all over the world.

2. Literature Review

Even though traditional museums have always been an important part in the preservation of certain historical remarks, with the help of the advancement in 3D modelling technology, virtual museums are becoming more popular. Virtual museums provide visitors an entirely new viewpoint on the exhibits and collections especially if the virtual museum displays three dimensional models. Numerous studies have examined the benefits and drawbacks of physical and virtual museums that employ 3D models.

A study conducted by K.Lee and C.Koo [1] shows that through the use of immersive and interactive experiences using 3D models, virtual museums can improve the users' experience and their educational results. Apart from this, they also discovered that virtual museums can be more effective at attracting people who might not otherwise have the chance to visit a real museum because of travel or financial constraints.

Similarly, Perry and Kaplan's [2] analysis of the literature showed that virtual museums with 3D models may be effective learning environments that improve students' motivation and engagement with their coursework. The assessment also highlighted how virtual museums can encourage teamwork, critical thinking, and active learning.

Gai, Li, and Zhang [3] conducted an investigation study to compare how visitors gained knowledge in 3D-model-equipped traditional and virtual museums. According to the results, virtual museum visitors were more engaged and interactive, which can help with memory recall and information retention.

Additionally, Drotner and Schroder [4] emphasize how 3D virtual museums may expand the scope of traditional museums beyond the limits of time and location by making displays and collections accessible to a larger audience via online platforms. Social media gives virtual museums another channel for interacting with visitors and promoting community involvement.

The preservation and documentation of cultural heritage through the creation of digital twins, specifically 3D models, plays a crucial role in safeguarding and promoting cultural heritage assets. Platforms like Europeana [5] have recognized the significance of digitization in preserving and sharing cultural artifacts with a global audience. Building digital twins of cultural heritage assets allows for their virtual representation, ensuring their accessibility and long-term preservation. These 3D models provide an immersive and interactive experience, offering new perspectives and insights into cultural heritage. They enable remote exploration, education, and research, outside geographical and temporal boundaries. By leveraging technology, cultural heritage preservation becomes more inclusive, allowing diverse audiences to engage with and learn from these invaluable artifacts. The construction of digital twins enhances documentation efforts, ensuring that these cultural treasures are conserved and made available for future generations to appreciate and study.

In conclusion, research indicates that virtual museums using 3D models could provide visitors with a distinctive and fascinating experience, especially for people who might not have access to traditional museums. Using technology, museums may connect audiences beyond geographical boundaries and encourage active learning and creative thinking. However, it's crucial to take into account the drawbacks of virtual museums, such as the requirement for technological expertise and the possible loss of sensory experience, and to create exhibitions that are user-friendly and accessible.

3. Design of the Solution & AI Techniques Used

To decrease the problem that traditional museums face, more virtual museums can be employed so that the problems mentioned before will be mitigated. In this task as a team we created a virtual museum that showcases some of Valletta's stunning and historic landmarks.

The advantage of implementing virtual museums is that visitors who are unable to visit the museums physically or have other issues can still be able to engage. Apart from this, users can access the virtual museum at anytime and anywhere in the world. Nonetheless, people who have impairments, mobility problems, or those who might not be able to travel could find these very helpful.

Virtual monument museums can also offer a more immersive and interactive experience. In a way that is not feasible in conventional cultural institutions, visitors can engage with the exhibits by rotating them 360 degrees, zooming in to look at specifics, and more. This can increase visitors' interest in the displays and help them spend more time learning about history and culture.

Virtual monuments museums may also be less expensive than conventional ones. A physical museum's setup and upkeep can be expensive, requiring a sizable investment in employees, infrastructure, and resources. In contrast, online museums may be updated and maintained more affordably and easily with minimal expenses.

All things considered, virtual monuments museums provide distinct advantages and experiences that can enhance regular museums and give visitors new opportunities to explore and learn about history and culture.

With these points in mind, some requirements that the online virtual museum should satisfy are:

- Provide an interactive experience through interactive viewers, allowing visitors to rotate exhibits, zoom in for closer examination, and engage with specific details.
- Be accessible at any time from anywhere, allowing visitors to access the virtual museum remotely, regardless of their geographical location.
- Exhibit high-resolution 3D replicas of cultural heritage assets, providing a realistic and immersive representation of the monuments.

To meet these requirements, the final outcome of this product seamlessly integrates web-related technologies, visualization tools, and computer vision/photogrammetry software for the 3D reconstruction of cultural heritage assets. Web-related technologies like HTML, CSS, and JavaScript make it easier to develop an accessible and user-friendly online platform that makes it simple for visitors to engage with the virtual museum. Because of these technologies, the virtual museum is widely accessible and compatible with a variety of devices and browsers. The creation of precise and comprehensive 3D models of the cultural heritage assets makes use of WIDAR [6] software, which was developed particularly for 3D modelling.

Some of the most common AI techniques used in this task to build this virtual museum were, computer vision and 3D modelling. Computer vision played an important part when forming the monuments models. This method uses algorithms and machine learning models to analyze images and extract information from them. Computer vision makes use of image segmentation so that it can be applied to a 360-degree monument to recognize and separate the monument's various elements from their surroundings and to stitch together multiple images to provide a seamless 360-degree view. This can let viewers focus more on the monuments themselves and might enhance the website's appearance.

AI methods, such as machine learning algorithms, can be used to train models to create 3D models of the monument from a variety of photos or videos. This can be utilized to produce precise 3D models of the monument that can be viewed from all angles.

By utilizing these tools and techniques, the virtual museum successfully presents Valletta's beautiful and historic sites while offering visitors of different cultural backgrounds an inclusive, engaging, and educational experience.

Figure 1: WIDAR application logo

4. Implementation

Prior to designing the Online Virtual Museum website, some research was done to take note of what functionalities and components would be useful for our website. It was at this stage that the Underwater Malta Virtual Museum website [7] was found, which inspired us to create a similar website for the monuments found in Valletta.

This web application is made up of underwater archaeological sites. The main idea of this was to let people that are not divers or people in submarines to be able to visit these sites. This virtual museum have multiple models that one can access. Once the user selects the model they have the chance to read more about it, load the virtual model, view the video as well as view gallery.

Following this research we gathered as a team to distribute the work. Mark Dingli was given the front-end part of the web application, Nicholas Vella was tasked with obtaining the three dimensional models of the monuments and Marcon Spiteri was responsible for the report, as well as, the presentation and the brief background history of each monument. It is important to outline that although every member was given a particular task, whenever it was required, we helped each other.

Visitors can explore Valletta's monuments through 360-degree models on the Virtual Museum website. The website showcases images of the beautiful capital of Malta, Valletta. The online virtual museum has a responsive design and is accessible on all devices. The home page greets users with a welcoming message, it also provides access to the three dimensional monuments models. Here the user can see a picture of each monument and when they hover on the image the name of the monument will appear. The home page also features an interactive map that shows the location of each monument. When clicked on a pin, the monument’s name along with a link (for more information) can be found. To display the map, OpenStreetMap was used. When a monument is selected, a new HTML page featuring a 360-degree view of the monument is shown. By clicking, dragging the mouse, zooming in and out, and navigating the monument with the pointer, the user can interact with the model. The historical background, architectural features, and intriguing information about the monument are also included on this page.

The team's objectives for the project are described in depth on the website's "About Us" page. The team's commitment to preserving and making accessible Malta's rich history and culture is emphasized in this statement.

Each HTML page is designed to be user-friendly, with intuitive navigation and clear instructions for accessing the models. Modern technology has been used to meticulously create the 3D models to assure authenticity and realism, giving users an immersive and interesting experience. The website's footer contains details about the Virtual Museum, such as contact details and social media connections. In addition, it contains links to the home page and "About Us" page. The logo is also present at the bottom, and clicking it takes the user to the homepage's header.

We used particular tools and a methodical process to capture the three-dimensional models of the monuments for the Online Virtual Museum. Comprehensive photos of the monuments from a variety of perspectives using high-resolution phone cameras were taken. A tripod was utilized as it extended the reach of the camera to photograph the monuments that were at high angles. This made it possible for us to gather the photos required for the 3D reconstruction process and to get complete coverage of the monuments. We were able to gather the required data and produce accurate 3D models for

the monuments featured in the Online Virtual Museum due to the equipment selection and organized approach to taking the pictures.

Parameterizing WIDAR [6], a cutting-edge photogrammetry tool, was necessary for the 3D reconstruction process. To create precise and accurate 3D models, we carefully adjusted the software's parameters, such as picture alignment settings and mesh reconstruction parameters to produce a 3D models that are both clean and detailed. We wanted to improve the reconstruction process in terms of accuracy and efficiency, which produced realistic 3D models, by using these less complicated parametrizing approaches.

This Online Virtual Museum serves as an innovative educational tool that allows visitors from all over the world to experience Valletta's landmarks. It is a precious resource for anybody interested in Maltese history and culture because of its user-friendly design, excellent 3D models, and extensive background information.

Figure 3: The 3D model after scanned

Figure 2: All the models saved in WIDAR application

5. Evaluation & Results Obtained

During this phase, the three dimensional models of the monuments were evaluated for any cut-outs or deformities brought on by the WIDAR application. In cases where the models were cut out, further editing was required to make them look better and more complete.

Also, when testing out the 360 degree models, it was noted that the monuments were facing in the opposite direction. To combat this, some functions within the html were employed so that the monuments face in the right direction and can be easily moved, rotated and zoomed in or out by the user.

In order for the virtual museum to work correctly the file path needs to be as follows "GAPT-main/Virtual_Museum". If the path is different then the web application will not work.

An important point to outline is that due to the fact that some monuments were placed at higher levels or were too tall, certain parts of them were difficult to reach, although having the equipment. As a result, some of the monuments resulted in cut-outs or less complete models. Overall, the testing and evaluation process helped us as a team identify the issues with our 3D models and therefore fixed these issues to make the virtual museum more user-friendly and engaging for our users.

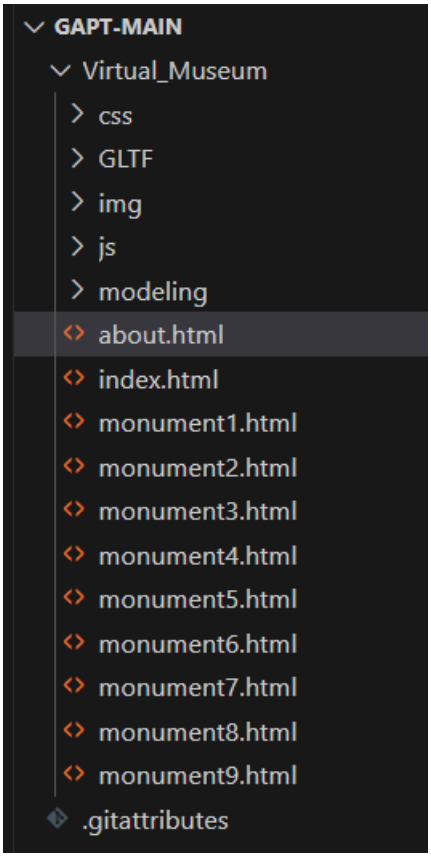


Figure 4: How the file path should be to work correctly

6. Conclusion

Throughout this project, our team embarked on a journey that provided us with valuable insights, learnings, and experiences. As we delved into the world of 3D modelling and virtual museum development, we encountered both opportunities and challenges that tested our skills and determination. Reflecting on our collective journey, we can identify several key takeaways.

Such a project, made us aware of the enormous potential that technology, particularly 3D modelling and virtual museum platforms, possess in protecting and exhibiting cultural assets. We have seen how these digital representations might provide tourists a fresh and immersive approach to learn and connect with historical places by photographing and examining 3D models of Valletta's monuments. It has made us more aware of the potential of technology to deepen our understanding of our fascinating past while improving interaction with other cultures.

Nonetheless, we still encountered some challenges throughout this project. One hurdle that we encountered was capturing 3D models for monuments that are situated at high angle. Although having equipment such as high-resolution cameras and a tripod it was still impossible. We had to meticulously plan our approach, experimenting with different positioning and angles to ensure accurate and detailed captures. This challenge taught us the importance of adaptability and resourcefulness, as we had to think creatively and problem-solve on the spot.

Additionally, as a team, we developed a stronger understanding of the value of cooperation and good communication. Each team member contributed a special set of skills and expertise, which helped the project to succeed. We discovered the value of listening to one another, asking for input, and collaborating effectively to get tasks completed. Our ability to work together helped us overcome challenges and produce a final result we are proud of.

In conclusion, this project has been a transformative experience for our group. We have seen how technology can be used to safeguard and showcase cultural heritage in new and fascinating ways. We have overcome obstacles and refined our 3D modelling abilities by capturing 3D models of Valletta's monuments. Along with deepening our awareness of our cultural history, this initiative has also emphasized the value of teamwork, adaptability, and creativity. We are pleased with the results we obtained and all the invaluable knowledge we acquired from this project.

Distribution of Work

As a group, we discussed how the work was going to be split in order to start working on the assignment. The description below shows how each teammate contributed for this assignment:

Mark Dingli (0020703H):

- Built and designed the web application that displays the 3D models. Also modified the models that were incorporated into the web application, in order to make sure that the models could operate properly with the web application.

Nicholas Vella (0440803L):

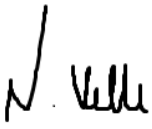
- Physically went to Valletta to capture high-resolution scans of historical monuments, with the objective of producing 3D models of these artifacts. Also responsible for uploading the 3D models onto the website.

Marcon Spiteri (0032203H):

- Conducted the report on the web application and the tools used, searched and wrote on background context of each monument and created the PowerPoint presentation. Also obtained Valletta's map from OpenStreetMap.

We, the undersigned, agree that this distribution of work is as reported above and was satisfactory for the whole team.

Mark Dingli



Nicholas Vella

Marcon Spiteri

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