

ArtSync

by

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Intent

The following contract was written and agreed upon by Rahul Bhagwat, Lydia Lopez, Joe Boylson, and Christian Lance.

The contract provides expectations, objectives, and results for developing ArtSync.

The contract is effective for all team members participating in IT 5001/5002 through the 2021-2022 academic year.

Abstract

This team of web and game developers came together through a common desire to build a product that was both an immersive experience and a tool accessible through a common web browser. The team identified a problem that content creators are now facing due to the closure of art galleries and because many experiences are now becoming virtualized, an opportunity in the market was identified. Furthermore, there was personal motivation for some members of the team to build the product that they themselves wanted to use for their own artistic endeavors. This is how and why the team decided to build ArtSync, a virtual gallery environment which will allow artists to showcase their work and share it across the internet.

ArtSync is made up of two main parts: a game built inside Unity and a website which has access to a database. The Unity game contains the 3D realistic environment, the movement controls, the rendering of artwork, and the different actions to view the art. The website takes care of the other elements that a user experiences: authentication, file uploading, gallery management, and permissions. Separately, both parts are interesting enough; but by integrating these two parts together, the team created something unique.

To embed the game inside the website, the team used Unity's WebGL exporter which bundles the project into something that a web browser can read. The product sends data back and forth from the Unity export through the use of an open-source JavaScript library called [react-unity-webgl](#) and [custom javascript events](#). With these methods, the team fully integrated the Unity game with the website and database into one cohesive product.

As a result, the team created a scene build inside Unity with all the controls functional, a basic front-end built out with React, and the basic construction of an API which reads and writes from a local SQLite database. With that, the team also created two use cases, technical diagrams and documentation, and the creation of the front end.

The team first created a proof-of-concept product which proved that the idea was *absolutely* possible and would not require a great amount of resources or extremely high technical proficiency. By this point, the team has worked out all the major issues of the project and moved forward into the enhancement stage where the team turned this app from a proof-of-concept into an alpha release.

Introduction

Project Summary:

The team built a platform for virtual artists, 3D designers and content creators of all kinds to showcase their work online in a virtual art gallery.

Problem Statement:

Virtual artists do not have a space to showcase their work. Due to COVID-19, the vast majority of galleries temporarily closed down and online art sales rose (The Art Basel, 2020). Due to this, the supply for viewing/purchasing art has surpassed the demand and while for-profit art exhibits are thriving, non-profit art exhibits are closing down (Tarmy, 2021). Furthermore, the cost of renting a gallery space is often a barrier of entry for new artists, and those who rent only have access to the gallery for a definite amount of time.

Solution:

The team created a platform where people can upload art to a virtual art gallery for other people to experience their 3D designs, physical art, and virtual art pieces in a realistic manner. Not only is this application time-based and space pivotal to show work online, but it is also critical to galleries and museums to enable these dynamic, multi-faceted perspectives (Dziekan, 2005, p. 7). This platform provides a gallery accessible to anybody with a web browser; there are no cost for artists and the gallery can remain open for as long as the artist desires.

Project Source:

This team of web and game developers came together through a common desire to build a product that was both an immersive experience and a tool accessible through a common web browser.

As well as being developers, members of the team are artists themselves in various mediums, such as 3D Art and Animation, Photography, and Game Design. The team decided to put effort into creating a virtual gallery platform that would allow artists to showcase their work virtually and allow viewers to immerse themselves in a gallery-like environment.

A large part of the inspiration for this project came from Matterport, a company that specialized in the virtualization of physical spaces and offers a platform to view the virtualized

space (Matterport, 2021). Furthermore, Matterport also allows the uploading and placing of 3D objects into the virtualized space.

Matterport does not fit this project's requirements and the team decided to work towards creating unique gallery environments with Game Development software (Unity) and integrating them with a content management system which allows artists to upload their work and place them anywhere in the environment.

ArtSync remains unique compared to Matterport by means of user accessibility, customization, as well as live environmental movement. ArtSync's users are able to make these environments their own by uploading both 2D and 3D work and sharing with others. Unlike Matterport, this project's environments are handmade rather than scanned into existence.

Discussion

Project Objectives/Goals:

The team wanted to develop a functional web interface that lets users upload their 3D/2D artwork and showcase it in a “virtual gallery” that people can walk through and experience like a physical art gallery.

The most important features of this application to integrate are the uploading of artwork into the gallery scene and the sharing of that scene with users. These core functionalities solve the problem outlined in the problem statement: an artist will have a space to showcase their artwork that is free of charge and time constraints and the online nature of this gallery will allow anyone with internet access to view the gallery.

The team first focused on the basic implementations of the 3D scene and the backend of the application, then focused on integrating these two portions of the application together. After this, the team then wanted to focus on enhancing the scene(s) and adding additional frontend features and styling. Finally, user testing was performed to find and fix any bugs.

Team Members and Responsibilities:

Web Developer: Joe Boylson

- Created the backend/database for people to upload artwork
- User authentication

Frontend: Rahul Bhagwat

- Created UI for web interface

3D/Unity Developer: Lydia Lopez

- Found/developed 3D textures
- Level design
- Assisted with mechanics, scripts, and integration

3D/Unity Developer: Christian Lance

- Created/developed the unity 3D interface, mechanics, and unity scripts for navigation.
- Integrated backend to Unity

Project Scope:

ArtSync allows artists to upload and share their art to a virtual space that others can view. Users are able to add to an existing gallery or fill their own personal gallery. Users also are able to view others' galleries for free online from all over the internet.

Features:

- Website with authentication, profile, file upload functionalities.
- Ability to place art inside specific gallery at specific art locations
- Ability to create public or private gallery
- Ability to inquire directly about purchasing ones' artwork
- Unity game playable through WebGL
- Showcase work in different galleries of the users' choosing
- Additional gallery spaces

Optional features:

- VR experience
- Enhanced user customization (avatar, gallery textures)
- Artwork rating system
- Multiplayer functionality

The optional features still fit the solution and project goals as the main idea and functions remain. The additional options will only enhance the user experience by means of customization, flexibility, and interaction with other users.

Quick Project Timeline:

Task #	Task Name	Duration	Start Date	End Date
1	Repository creation / git workflow setup	1 week	9/20	9/27
2	Basic backend development	3 weeks	9/20	10/11
3	Basic scene creation	2 weeks	9/27	10/11
4	Integrate application and game	2 weeks	10/11	10/25
5	Develop functionality to load assets	2 weeks	10/25	11/08
6	Prep for proof-of-concept presentation	2 weeks	11/01	11/15
7	Basic Frontend development	1 week	11/08	11/15
8	Level design	3 weeks	01/10	01/31
9	Finalize frontend website development	3 weeks	01/10	01/31

10	Additional game functionality	3 weeks	01/31	02/21
11	Public/Private gallery setting/interface	3 weeks	01/31	02/21
12	User Testing + bug fixing	2 weeks	02/21	03/07
13	Polish and finalize project	2 weeks	03/07	03/21
14	Finalized Project Presentation	3 weeks	03/21	04/12

Technologies Used:

Frontend:

Unity - Versatile game development software that can export the game scenes into a web browser.

WebGL - A web browser graphic renderer that Unity can export to.

HTML - Code for website interfaces

CSS - Code for website interface customization

JavaScript - Code for frontend development

Backend:

C# - The coding language that is compatible with Unity.

Python – Code for backend development

SQL - Can be used to store and retrieve user data.

Technical Architecture Diagram:

The following is a diagram depicting the technical architecture of ArtSync. The project is fairly straightforward; the client side is a React application and contains an embedded WebGL that is exported from Unity. The client side also interacts with a Python Flask application which holds the business logic and authentication layers. Data is stored in a Postgres database. The Flask application and the database are hosted on a chosen server.

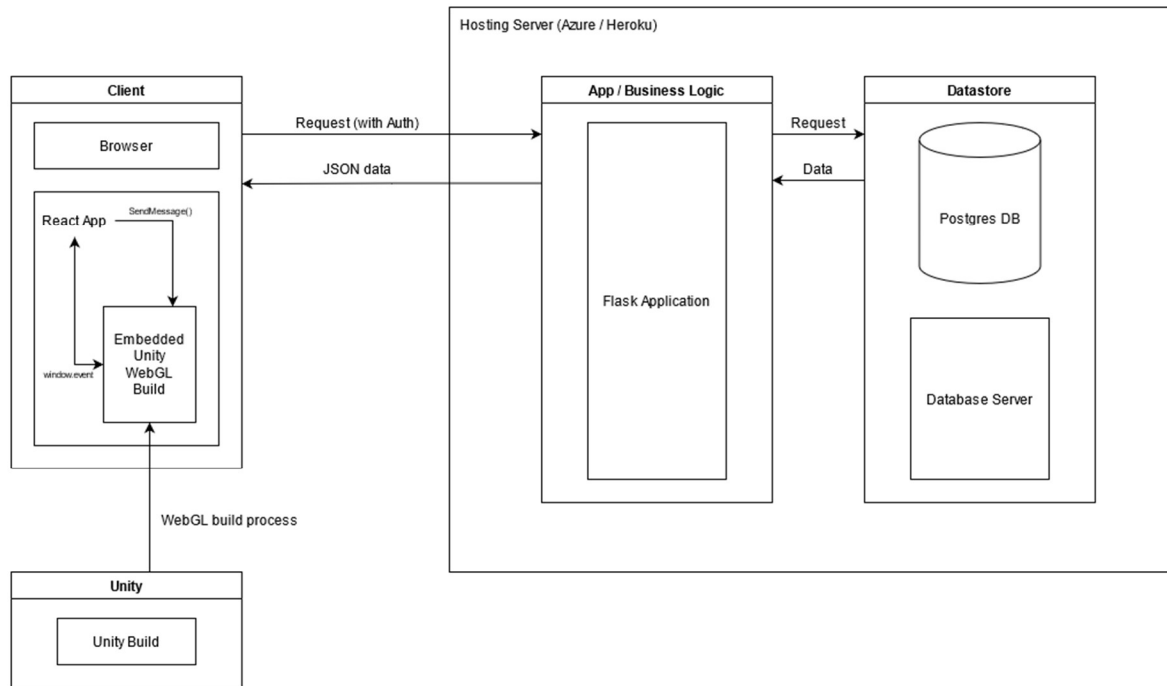


Figure 1: Technical Architecture Diagram

User Personas:

ArtSync has multiple ways of being of use to the public. The following user personas represent fictional user types that could utilize ArtSync in a variety of ways:

Mark is a 3D artist who works as a product designer for a P&G. In his spare time, he likes making digital sculptures. He has a plethora of 3D artwork that he has made over the years. He needs a place to display all this digital art to be easily shareable with the world. He tries services like art station, etc. but none of them offer the kind of capabilities he needs to display his artwork.

He then stumbles upon ArtSync where he can create custom galleries and upload his 3d files to be viewed in a 'virtual space' like actual objects.

He creates an account and starts to upload his files there. He then clicks on create new gallery, names his gallery and starts placing the 3D art he wants into his gallery. Once he has everything set up, he publishes the gallery and shares the link with all of his friends.

User Persona: 1	
	Title Product Designer
	Name Mark
	Age 22
	Gender Male
Picture	
Behavior	Is an artist and loves making 3D virtual artwork
Pain	Has a lot of virtual artwork, does not have any platform to display it online
Needs & Goals	Needs a place to display his virtual artwork online where he can easily share it with people and have an actual “gallery-like” experience watching the 3D art in a 3D space and interact with it and view it from different angles and sides.

Figure 2A: User Persona 1

Lisa is a professor who is very passionate about art. She loves physical as well as virtual art but is never able to find galleries for virtual art and discover new 3D artists.

One of her friends recommended her to use ArtSync. She then signs up for the website and is very happy to see that she can browse through different peoples publicly posted 3D art galleries and have the same experience as she would in a physical gallery by walking around and viewing different art.

User Persona: 2	
	Title Professor
	Name Lisa
	Age 23
	Gender Female
Picture	
Behavior	Is an art-lover and likes viewing virtual art
Pain	Has no place where she can go to see virtual artwork that recreates the physical experience
Needs & Goals	Needs a virtual interface where she can go see virtual art in a physical-like setting and discover new virtual artists easily.

Figure 2B: User Persona 2

Use Cases:

Similar to user personas, the following use cases represent different scenarios and situations in which ArtSync may be used:

Use Case ID	1
Use Case Name	Artist
End Objective	Being able to display 2D-3D virtual art in a ‘virtual’ gallery location for others to view
User/Actor	Virtual artist
Trigger	Need to display their art
Frequency of Use	Whenever they have new finished artwork
Preconditions	Needs to have finished virtual artwork
Basic Flow	Goes to website, makes account, uploads artwork, adds into a gallery and publishes it.
Alternate Flow	
Postconditions	Art is viewable and shareable on a gallery on the website for the general public.

Figure 3A: Use Case 1

Use Case ID	2
Use Case Name	Viewer
End Objective	Being able to view 2D-3D virtual art in a ‘virtual’ gallery location made by other artists.
User/Actor	Art-lover/appreciator
Trigger	Need to look at art
Frequency of Use	Few times a week
Preconditions	Need to have a love of art
Basic Flow	Goes to website, makes account, opens galleries on the main discover page and looks at different art.
Alternate Flow	
Postconditions	Is able to see different artists’ virtual art.

Figure 3B: Use Case 2

Use Case Diagram:

The following use case diagram is a visual representation combining both the user personas and use cases:

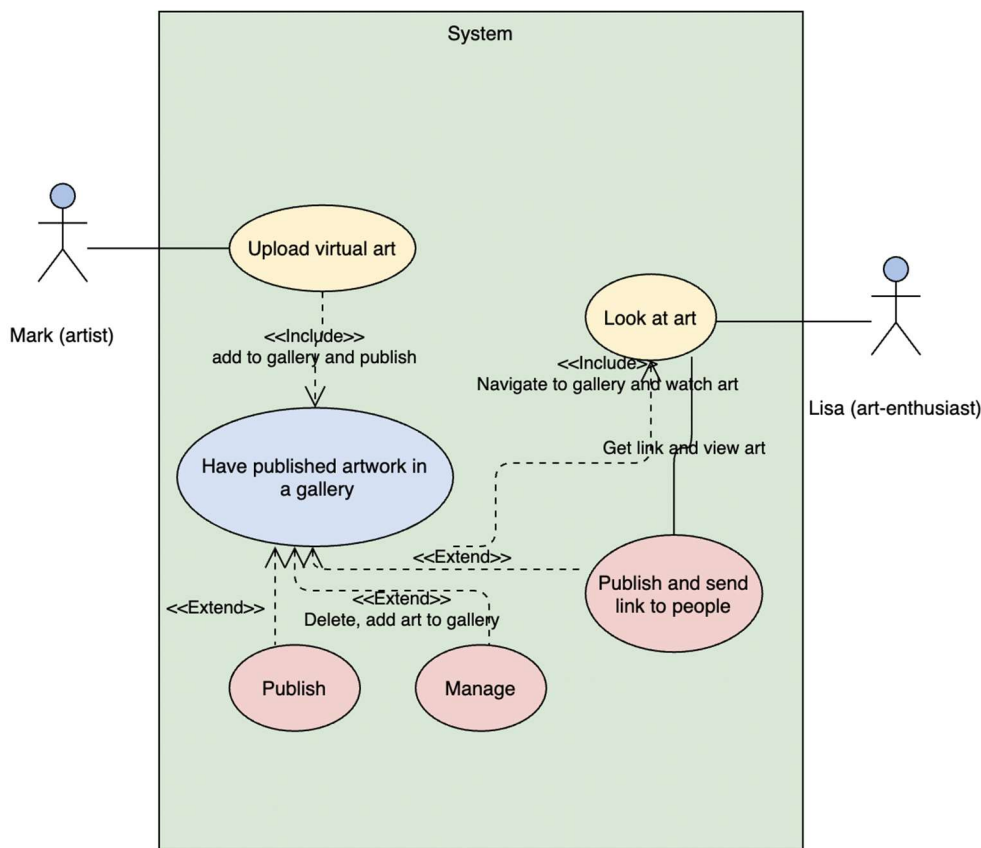


Figure 4: Use Case Diagram

Ethical Considerations:

Users can upload their creations to a gallery which can be viewed by others. This means that there must be some level of passive and active moderation to prevent harassment and overtly offensive content from remaining or entering one of the gallery spaces. This could be done via language filters, active moderators, or open community moderation.

Users will also be signing up and signing into the service, which means that their data could be leaked. The team must limit the amount of data that is collected and protect that data from being breached.

To prevent piracy of digital artwork, the product will be utilizing compressed versions of the uploaded artwork as well as implementing file size limitations.

Testing Plan:

Overview

The team formally tested use cases as needed to ensure major functions are working properly and will record procedures and outcomes. To further ensure all functions are working properly and the user experience is thoroughly developed, family, friends, and colleagues of the team will test ArtSync from the web application. The following section will outline the intention and direction of ArtSync's testing process. Included below is the methodology, scope, objectives, test logs and procedures, and testing review.

Methodology

The team will be testing intermittently after:

- Implementing new major features
- Making major changes
- A major bug is discovered

And before:

- Major deadlines
- Presentations

The team decided to use this approach because many of the systems work independently, and it is unlikely for any minor features to interfere with other processes.

Scope

The team will be testing use cases 1 or 2, depending on what functions were modified. These use cases include the major requirements of ArtSync, and are accurate ways in which a user will need to utilize and navigate the gallery and web application. These major features include uploading new art, replacing existing art, deleting art, viewing art, and navigating/fully using the

web application. End-users selected for user acceptance testing will focus on delivering feedback on user experience, as well as reporting issues they may encounter.

Objectives

- a. All major features and use cases need to be accounted for
- b. All use cases must account for all the user roles
- c. All major bugs need to be resolved before proof-of-concept presentation
- d. All bugs need to be resolved before IT Expo

Test Logs and Procedures

Item#	Case#	User	Role	Expected	Actual	P/F	Reason	Date
1	1	Joe	Dev	Image load	Image load	P	Proof of concept presentation	11/08
2	1	Joe	Dev	Receive functions	Functions received	P	Changes made	1/24
3	1	Joe	Dev	Receive data	Incorrect data	F	Development	1/31
4	1	Joe	Dev	Receive data	Data received	P	Development	2/5

Testing Review

ArtSync's testing methodology allowed for security and thoroughness, ensuring that the project worked as intended. By diligently testing the use cases, the team was able to touch all the major features and points that the user encounters. The team quickly learned what features needed more time or reworked and allowed for a more agile approach to the project. Testing each major feature and change as they were implemented allowed the team to move through the project optimally so that issues did not stack.

Change Management Plan:

Anyone on the team can request a change under the circumstances that it is necessary or provides significant improvement. Priority will be given to changes that affect the key features and use cases of ArtSync. Changes that affect secondary features will be treated with less urgency. The approval process within the team will be based on a majority vote. Key features that are mentioned in the use cases are considered more critical than secondary features that are not necessary to the system. Changes that affect the identified key features will be communicated with stakeholders through meetings and/or e-mail.

Budget:

ArtSync's budget includes consideration for labor, software, hardware, and miscellaneous items. The following is the budget required to create this project.

						Ongoing Annual
	Rate Per/Hr	Work Effort (Hours)	1 X Costs	Rate Per/Hr	Work Effort (Hours)	1 X Support Cost
Labor - IT	20	100	\$2000	20	450	\$9000
Labor - External						
Software - External						
Hardware - External						
Misc.						
TOTAL	20	100	\$5000	20	450	\$9000

Figure 5: Project Budget

Problems Encountered and Analysis of Problems Solved:

WebGL performance issues:

Switching browsers to Firefox improved the performance of the WebGL build. The team needs to find more ways to increase FPS in the WebGL build.

No streamlined way to load .obj files into game from the web:

The team loaded text into the game instead of the .obj file and created an object based on the vertices written in the loaded text.

Sizing with .obj files is based on number vertices, so objects can generate with infinite size:

Code was introduced to adjust the size just after generating the object, and then make the object fall into place. Colliders are generated after the object is re-sized to prevent unintended interactions.

HerokuApp had limited file capacity, stopping us from testing uploading to a server:

The team is using local directories instead of servers until we have an official server to utilize.

CORS policy blocks using many files from the web in WebGL:

There is no good solution to this issue until we develop our own server, we just cannot use many files from the web.

Sending messages to the WebGL build from React.js, and vice versa, only allows one variable when we use three to four:

The code converts the variables into a string and the string is parsed, and variables are assigned thereafter.

Difficulty designing gallery scene to be consistent and realistic:

This issue came with multiple textures and 3D assets throughout the scene. In order to solve this, textures were hand edited and 3D assets were adjusted in order to make scene believable and realistic rather than stylized.

Gallery scene lighting glitch and post processing not being built:

When moving throughout the scene, lighting tended to glitch on and off. In order to fix this, the type of light had to change to “important” within render settings. The post processing was fixed by ensuring WebGL 2.0 was being used, as well as adding the post processing layer to the player prefab camera.

Difficulty correctly converting UI in figma to react code:

Initially a plugin was being used to convert figma frontend UI to react code, this was a bit buggy and later on just needed to be fixed by manually looking through and debugging code.

Lights glitching in gallery scenes:

Found that lights were glitching on and off while moving throughout the scene. Fixed this by setting all lights priority to “important.”

Found a glitch where the user can glitch through a wall:

Found that although the collider looked correct, it had to be expanded to about 125% so that the glitch was mitigated. The expanded collider is not obvious and does not change the viewing experience.

Conclusion

Each member of the team gained valuable lessons regarding communication and project management as a whole. Collaboration is highly beneficial in producing polished work on a tight timeline. While the team was able to stick closely to the original project ideas, it is now understood how much flexibility is needed when working on different features that can prove to be more challenging.

Along the lines of project management, each team member has gained valuable experience with communication, organization, and time management. Working together as a team has also allowed for further enhancement of collaboration skills. The team's game developers enhanced their skills with Unity and coding in C#. The game developers also learned how to collaborate on Unity projects using GitHub. The team's web developers learned a lot about the WebGL engine, how it works, and how to integrate it into the standard web stack. Furthermore, there were some lessons learned about the lifecycle of game development and how this lifecycle should work with the standard CI/CD practices of web development: instead of the standard "plan, develop, test, deploy" lifecycle of a web application, the team had to consider the development of the game itself which has its own development lifecycle.

The team continued to develop, test, and polish ArtSync throughout the year. New gallery settings were created, and level design will be polished for the best user experience. The frontend of the website was further developed and implemented to the final product. Once the final website was completed, the team implemented final touches such as hosting login, user authentication, basic security, etc., to create a fully practically functional product ready for real world usage. Permissions were also implemented to allow private and public gallery options for creators to select. Lastly, ArtSync underwent user testing and bugs were analyzed and fixed in preparation for the IT Expo in April of 2022. After all the major features have been implemented and if there is time left to develop ArtSync, additional features will be added such as direct donation methods, additional types of media, and multiplayer functionality.

References

- Art Basel. (2020, September 9). The Impact of COVID-19 on the Gallery Sector.
<https://artbasel.com/stories/the-impact-of-covid-19-survey-press-release>
- Dziekan, V. L. (2005). Beyond the Museum Walls: Situating Art in Virtual Space (Polemic Overlay and Three Movements). *The Fibreculture Journal: internet theory criticism research*, 0(7), 1 - 19.
- Matterport, Inc. (2021). Version (3.11.0). *Matterport*. Retrieved 2021, from
<https://matterport.com/>.
- Tarmy, J. (2021, February 23). Art Galleries Discover That Their Business Model Is Covid-Proof. Bloomberg. <https://www.bloomberg.com/news/articles/2021-02-23/art-galleries-have-been-thriving-while-museums-suffer-during-covid>