MALLOCI VR

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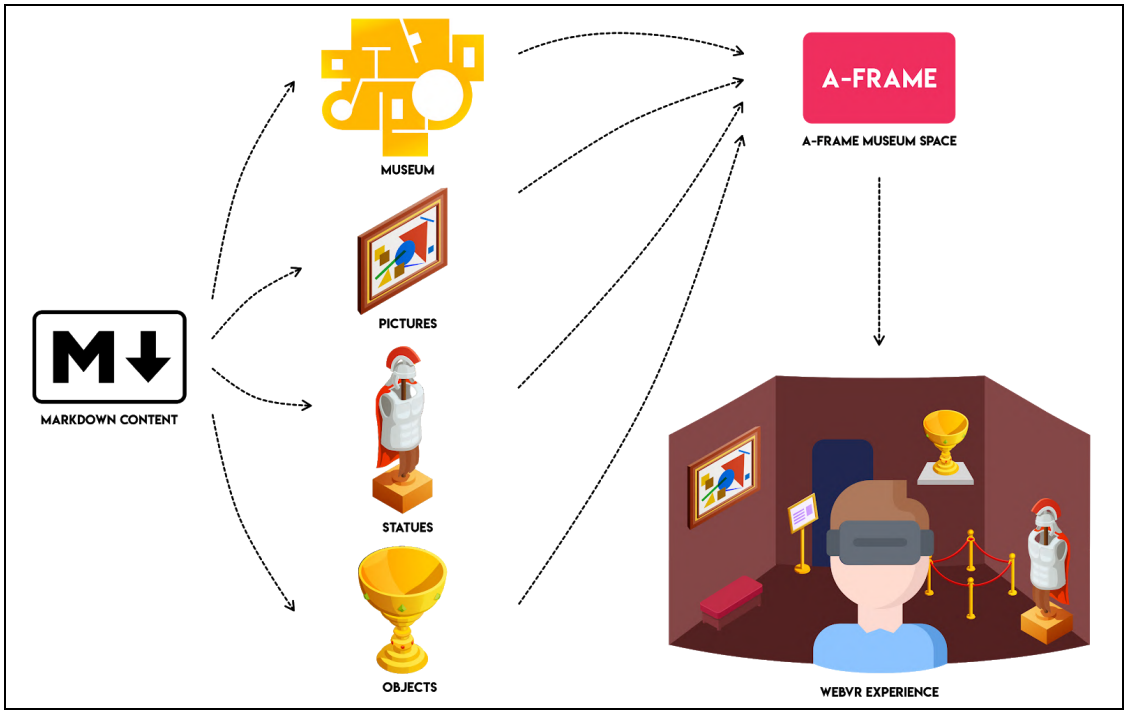
A Comprehensive Report on the Development of Malloci WebVR

Michael Gutensohn, Masha Belyi, Jennifer Momoh, Sharanya Soundararjan, Yejun Wu

School of Information
University of California, Berkeley

Introduction

Virtual Reality (VR) is anticipated to be the next major shift in personal computing. VR technology has evolved over the past decade from large headsets that require high-end desktop computers, to much lighter and self-contained headsets, and even lightweight devices that run on top of phones. However, while the technology has improved and become more accessible, the processes for creating and sharing VR content have remained roughly the same. At present, VR content creation requires an in-depth knowledge of software engineering, an understanding of game design and development, and access to expensive hardware. Once the content has been created, it must be actively maintained in order to ensure compatibility across various platforms. We believe that in order for VR to be considered a true personal computer, the processes of creating and sharing content must be as accessible and intuitive as content consumption. As such, we have designed and developed a set of tools that allows users to create web-based VR content through writing, a method of content creation that users are already familiar with.



Design

Research

At the core of Malloci is a rendering engine that synthesizes a 3d museum environment from text input. An important consideration in the development of Malloci was to incorporate elements associated with being in a physical museum into the generated VR space to enhance the appeal and memorability of the overall experience. The aim was to create an immersive, life-like experience that would be both viscerally and intellectually stimulating to anyone in the space. Any VR experience is typically quite memorable either due to the novelty of the experience, the other-worldly transformation of space or emotive interactions within the space. However, the current most common application of VR is gaming which requires a highly stimulating level of interaction to keep users engaged. Since our platform is more suited for display and less interactive than a gaming environment, we researched ways to maintain the same or a similar level of engagement and memorability while users wandered about the space. For example, a striking display of imagery enhances recollection either through strategic placement or visual enhancement. For a user to easily recollect not just the experience but also the exhibit, there needs to be an optimal balance between the state of flow created by the space and the objects within the space. The intention was simple: visit, view, engage, exit, recollect. This intention informed our use of lighting, object dimensions, distance between exhibits, colour contrast and even the selection of portions of text to be displayed. All these come together to create a truly stimulating but unforgettable experience. The concepts discussed below are the core areas of research that informed the design framework for Malloci.

Interactability

Malloci does not support highly interactive VR display at this time but since this is an attribute that is highly related to the memorability of any VR experience, there needed to be a way to bridge that gap. Research has shown that action and memory are intimately connected [12]. This means that recollection is higher at points of a scene where some form of decision making is required. In the context of VR, decision-making could be as simple as turning a corner or as complex as solving a puzzle to move from one level to another. To maximize the effect of decision-making on recollection, we have strategically placed the display of artefacts at points where the user is likely to make decisions with respect to navigating the space. We have also demarcated the space into sections and rooms, giving room for intuitive navigation.

Representativeness and spatial interpretability

Being able to make connections between the VR experience and real-life is important for remembering. When users are able to develop a sense of familiarity between an object in the space and one outside the space, it immediately creates a memory shift. To achieve this we have incorporated themes which are closer to real-life than they are to typical VR themes. The style of display and the experience of moving from one artifact to another will trigger memories of being in a museum for anyone who has previously had that experience.

Navigation

It is highly unlikely that a slideshow exhibition would be as memorable as one in which users had to navigate through by themselves. Keeping in mind that there might be restrictions with respect to physical movement within the space and that these restrictions may differ from one user to another, we have circumvented the need for physical movement while still leaving decisions of navigation up to the user. Irrespective of the device used to generate a VR display using this tool, movement within the space is not automated. This way the user is sufficiently engaged with the environment with less likelihood of zoning out.

Environmental Stimuli

People visit museums for various reasons. Reasons such as the casual, relaxing atmosphere, the aesthetics or the distinct ambience. All of these contribute to a feeling of fulfilment post-visit. Malloci allows the use of themed-display to create a visually stimulating environment. Also, every display is created with soft, ambient sound to create a feeling of relaxation. Malloci does not yet incorporate any form of user-to-user interaction nor does the space contain any 3D artefacts. Besides navigation, interaction within the space is mostly observational. With a lack of sound, users could become bored quickly or even experience anxiety as a side effect of the consciousness of being alone in the space and this could detract from the entire experience. The sound provides a buffer between the user and the silence.

Textual Display

Images are no doubt engaging to see but helping the user create some form of context around the images is essential for recollection. To this end, the tool also contains a text parser which transforms pieces of texts into exhibits. These texts are displayed in frames similar to the images and can help to provide contextual reference where needed. However, the text is kept short and succinct so that the user isn’t required to spend too much time reading. This maintains a fine balance between observation and interaction with the exhibits.

Though not implemented at this time, other elements identified during research which could contribute to the overarching goal of memorability are:

- Connected sight and sound. E.g. the sight of birds and a simultaneous bird-like sound;
- Amplified sound with increased proximity to source.
- Increased complexities in decision-making
- Object and space transformation
- Gamified experiences
- Sense of feeling e.g. slight vibration when certain action is taken
- Artificial lighting
- Customized music/sound
- Social interactions
- Navigational nudges

General Design Guidelines

Based on research, a set of guidelines were developed to inform the overall design of the space including - but not limited to - the architecture of the space itself, amount of text within each frame in the exhibit and background themes. These guidelines are detailed below.

Object display

- Maximize space. Avoid many unused spaces
- Objects should be placed at eye level and centered
- Object and labels should be as closely located to each other as possible such that the object and the label can be seen from the same vantage point
- Image and text should support each other. That is, they should not be repetitive of each other but provide additional context to each other
- Display objects against a plain background wherever possible, however, ensure optimal colour contrasts between artefacts and background
- Avoid double or cluster hanging of 2D objects where possible, except where necessary for interpretative reasons.
- When displaying several objects in the same square area, choose your "stars" and keep them prominent so that more of the attention is drawn to them
- Small 3D objects should be encased in glass so that they don’t seem irrelevant
- Recommended body text type is for VR is Frutiger
- Objects with heavy detailing are better hung at the midpoint of all the works so that people can look at them more closely and should be hung at a lower level if items are double or cluster hung

Lighting

- Behind or around object lighting can be used to draw attention to objects and images especially in dark-themed rooms

- Recommend contrast level between objects and background is 70%
- Rotating light which moves from object to object can be used provide direction of exhibition flow double or clustered displays
- Ceiling mount: direct light onto individual artworks is a great way of illuminating them. As a rule of thumb, ceiling-mounted lights should be placed so that the light beam hits the centre of the artwork when the fixture is adjusted to a 30-degree angle. A smaller degree of casting will create really long shadows below the frame. Casting too far back will cast a reflective glare.
- Use of lighting hanging down from the ceiling could be used to contribute to aesthetic

The VR environment

- The best environments have interesting horizons and detailed skies, but with calm or dark floors
- Human replicas with a close but missing likeness to reality could cause users to be repulsed that interested
- If a space requires low lighting compensate with lighter coloured walls
- Furniture should not project unpredictably into the navigation path
- Keep minimal details below the grid boundary. When the image below the floor grid boundary is full of details, it makes the grid appear to be levitated off the ground

Sound

- Any ambient sound should be kept low
- The orientation of the user should also affect the quality and magnitude of the sound (e.g., facing toward the sound or facing away).
- Avoid invisible or unidentifiable sources of non-ambient sound as it could confuse the user
- Non-ambient sound should grow louder as the user approaches the source. The sound should be related to the object. e.g. when a user hears birds, they are likely to look up because of their experience in the real world.
- Sounds need to contribute to the overall experience and not detract or distract from it

Environmental cues and nudges

- Avoid lag in movements
- Interaction should be intuitive. For instance, users should know if an object is meant to be approached or not. If it is part of the display or just aesthetics. For this reason, aesthetics should be themed to avoid user confusion
- Avoid abrupt and confusing changes to sound or environment or images
- A quick, light vibration might represent the user picking up an object while a more violent vibration could be a “don’t touch” signal

- Users shouldn't be required to make large arm movements to apply controls. It could be tiring and detract from the whole experience

General guidelines for user engagement

- The viewer shouldn't just be a spectator in the VR experience. Offer an active experience with decision-making rights. Action and memory are intimately connected. Keep viewer from zoning out and mechanically navigating through the space
- Gamify the experience such as providing rewards such as an unlocked new level if they complete a task. Give them something to look forward to
- Engage as many senses as possible
- Design an optional activate of narration for the visually impaired

Final Design Decisions

Default Space Design

Following the exhibit design guidelines, we created an universal architectural structure for our exhibits: users will be teleported into the VR exhibit after they clicks on the Malloci icon on our website, all the titles, subtitles and section headers will be displayed in big bold text on the floor directly in front of the entrance to each section (room). Inside the exhibit, text and images are displayed at eye level and loosely separated with each other, to make sure users won't miss any piece of them. At the end of each section (room), there's a corner designed for users to make a turn and enter into a new section (room).

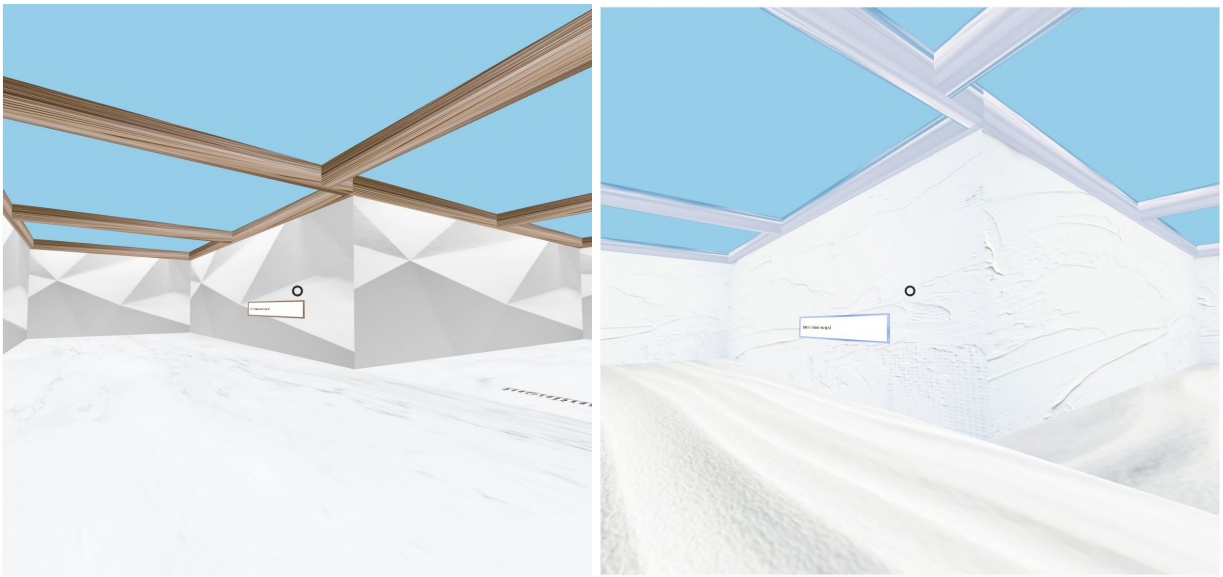
Default Style Guide

During the first stage of our project, we designed 4 different themes (Wood, White, Dark, Play) of the exhibit space to accommodate different content of articles. All the themes we designed included a detailed style guide to instruct the design of the ceiling, the wall, the floor, the frame, the pedestals, the lighting, colors and font (See Appendix).

However, as we managed to incorporate the important functionality that allows users to customize the theme (wall, floor, ceiling, frame and sky) for their own content, we narrowed down our style guide to focus only on two theme presets, one for the default space and the other for our Wikiparser.

The style guide of the default space is a combination of the previous Wood and White themes, with a white marble floor, white geometric walls, a wood ceiling, wood frames and a blue sky. Overall, we hope this space could remind users of a natural, delightful and spacious modern museum space that allows them to view the content

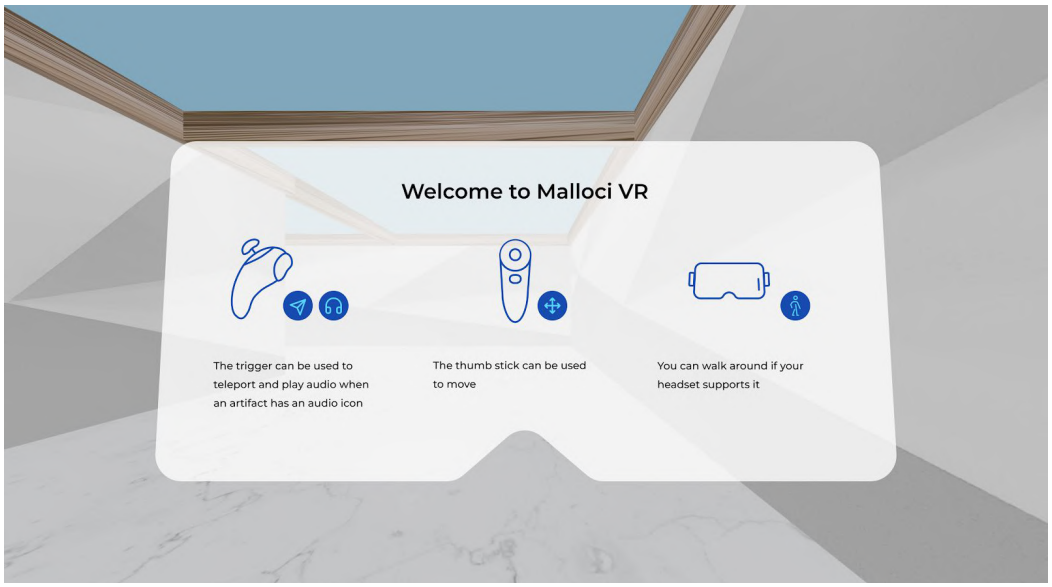
peacefully and mindfully. The style guide of the Wiki space follows the simple and clean visual design of the actual Wikipedia site, with a white floor, ceiling, and a hint of ocean blue.



Left: Default Space Design; Right: Wikipedia Explorer Space Design

User Guide

At the beginning of each exhibit, we will show users a simple user guide to teach them how to navigate within the exhibit. The design of our user guide follows our main color scheme (blue and white) and comes with a shape of a VR headset. Considering different users might have different controllers, we decided to focus first on the universal functionality (a trigger) that every VR headset has and then show some additional functionalities (for example, thumbstick) that only sophisticated headsets support.

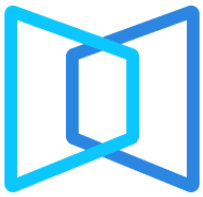


Ambient Background Music

Initially we tested the exhibit without any ambience music and we all agreed that it was too quiet and unnatural. Therefore, we picked a slow, peaceful and calming piano ambience music to match the look and feel of our modern museum design. The music will be played softly throughout the whole exhibit, but not too loud to stand out and distract the users.

Logo Design

In order to create a unique brand identity that speaks to our values, we also designed a logo based on the name “Malloci” and the VR experience. There are two overlapping and symmetrical blue planes in M-shape, which also indicates that a door will be opened to a magic 3D space. This logo is used widely both in our VR space and our website, playing an important role as a CTA and a home button.



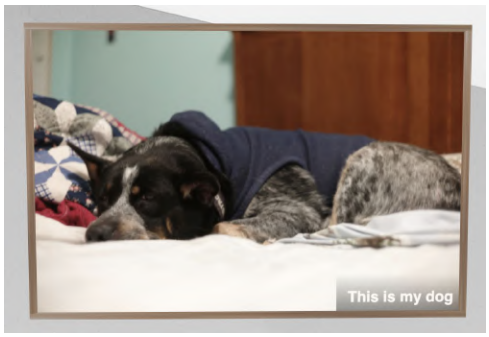
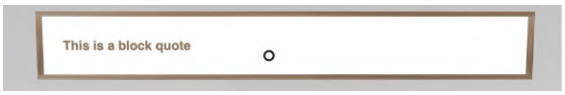
Implementation

VR MarkDown (VRMD)

In order to flatten the learning curve for VR content creation, we chose to implement MarkDown as our input framework. MarkDown is a well established simple syntax Markup Language, created as a simpler alternative to HTML so that a user can spend less time keeping track of while writing.

Remapping MarkDown Syntax Outputs

Our implementation of MarkDown deviates by how we have chosen to interpret it. We remapped the fundamental markdown syntax from HTML tags, to objects and structures in a virtual space. Headers create and title rooms within the museum space, and Images, Block Quotes, and Code Snippets create artifacts that will be hung on the walls of the room they’re in.

MarkDown	Remapped Output
# Title ## section ### Subsection	Each tag creates a room within the museum space, Single # define the name of the museum.
![This is my dog](val.jpg)	
> This is a block quote	
``` let ex = "Hello World" console.log(ex) ```	

Extended Syntax

After implementing the fundamental syntax of MarkDown, we wanted to extend the syntax for our unique purposes and to allow the user to tailor an exhibit to their tastes. The extended syntax introduces theming, the ability to attach a custom frame or an audio description to an artifact, and the ability to hide sections and artifacts of content from the article representation of an exhibit.

MarkDown	Rendered
$[walls](img.jpg) $[ceiling](img.jpg) $[floor](img.jpg) $[frames](img.jpg) $[sky](255, 255, 255)	set the textures of the walls, ceiling, floor, frames, or color of the sky (hex code or rgb).
![caption text](img.jpg) ^[audio](audio-file.m4	This audio file will be attached to the artifact on the line above it

a)	
> block quote > with custom frame ^[frame](img.jpg)	This will define a custom frame texture for the artifact on the line above it
![caption text](img.jpg) ^[frame](img.jpg) ^[audio](audio-file.m4a)	An artifact with a custom frame and audio description.
~ ![These artifacts](img.jpg) > Will be hidden > from the article > but will be visible > in the exhibit! ~	These artifacts will be visible in the VR museum, but not in the document view

VRMD Parser

A MarkDown document is interpreted using a parser such as Marked.JS, which outputs a formatted HTML document. It is at this point in the process that we deviate, rather than producing HTML, our MarkDown parser outputs a JSON structure to be used as a blueprint for the Malloci engine to generate the museum space, and MarkDown text cleansed of our extended syntax, which can then be interpreted by a standard MarkDown parser.

The Malloci Engine

The Malloci Engine is an AFrame component that receives a JSON structure produced by the VRMD Parser, and interprets it into a virtual museum space populated with artifacts.

Space Generation

We went through a few iterations of the space generation algorithm. The first of which was based on a treemap algorithm, partitioning a rectangular area based on the number of rooms defined by the user. While this was a technically efficient

solution, rooms would become crowded with artifacts and incomprehensible. Our initial solution was to define the depth of the space based on the room with the largest number of artifacts, but this resulted in less populated rooms looking too sparse.

The second version of the space generation algorithm is based on a very basic dungeon generation algorithm. For each room in an exhibit, we define the length based on the number of artifacts it contains, and whether the next room will be turning left or right based on a random number generator, and keep track of the number of left or right turns made by the previous rooms in order to prevent collisions.

Pseudo code:

```
rand = rand(exhibitTitle)
lefts = 0
rights = 0
For room in rooms:
        roomLength = room.artifacts.length * 4 + 3
        if(rand > 0.5 and lefts < 2 or rights == 2)
                buildRoom(room, roomLength, “left”)
                lefts++
        else
                buildRoom(room, roomLength, “right”)
                rights++
```

Seeding the random number generator using the exhibit title guarantees that the space generated for an exhibit will have the same layout whenever it’s initialized.

Artifact Placement

In order to avoid introducing additional complexity to the basic MarkDown syntax, we designed the artifact placing algorithm to be predictable and maximize linear flow. The artifacts array is split by even/odd indices, and the resulting arrays are placed on the walls in chronological order. The even numbered artifacts are placed on the wall that is facing the user as they walk in the room, ensuring the zeroth artifact in the room is the first to be seen.

Pseudo code:

```
oddArtifacts = room.artifacts.filter((v,index) => { return index % 2 == 1})
evenArtifacts = room.artifacts.filter((v,index) => {return index % 2 == 0})

if left:
```

```
        buildWall("right", evenArtifacts)
    buildWall("left", oddArtifacts)
else:
        buildWall("left", evenArtifacts)
    buildWall("right", oddArtifacts)
```

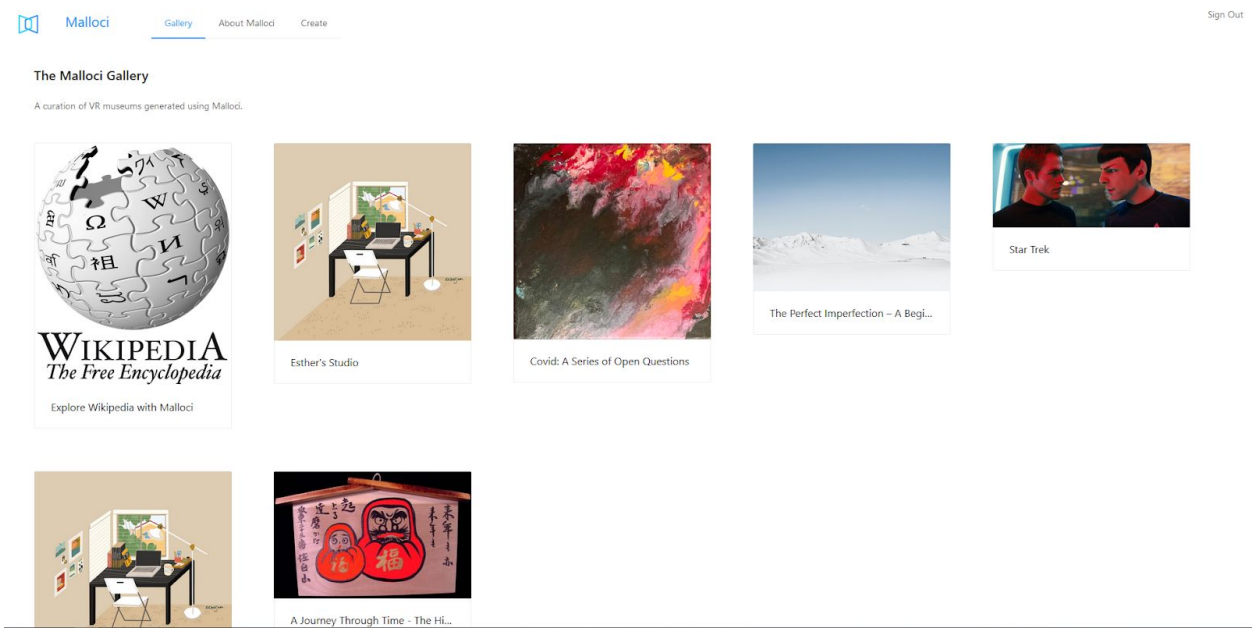
Platform Agnosticism

A fundamental tenet of this project was our vision for VR to be accessible to developers and consumers of all platforms. As such, we chose to build Malloci on top of Mozila's WebXR framework, AFrame. This allows us to inherit the affordance of universal compatibility across platforms and devices. With this as a springboard, we developed our experience to scale in accordance with detected hardware: when viewed on a mobile phone via a Google Cardboard headset, users navigate the experience using gaze tracking, while more advanced headsets allow for controller based or even roomscale navigation.

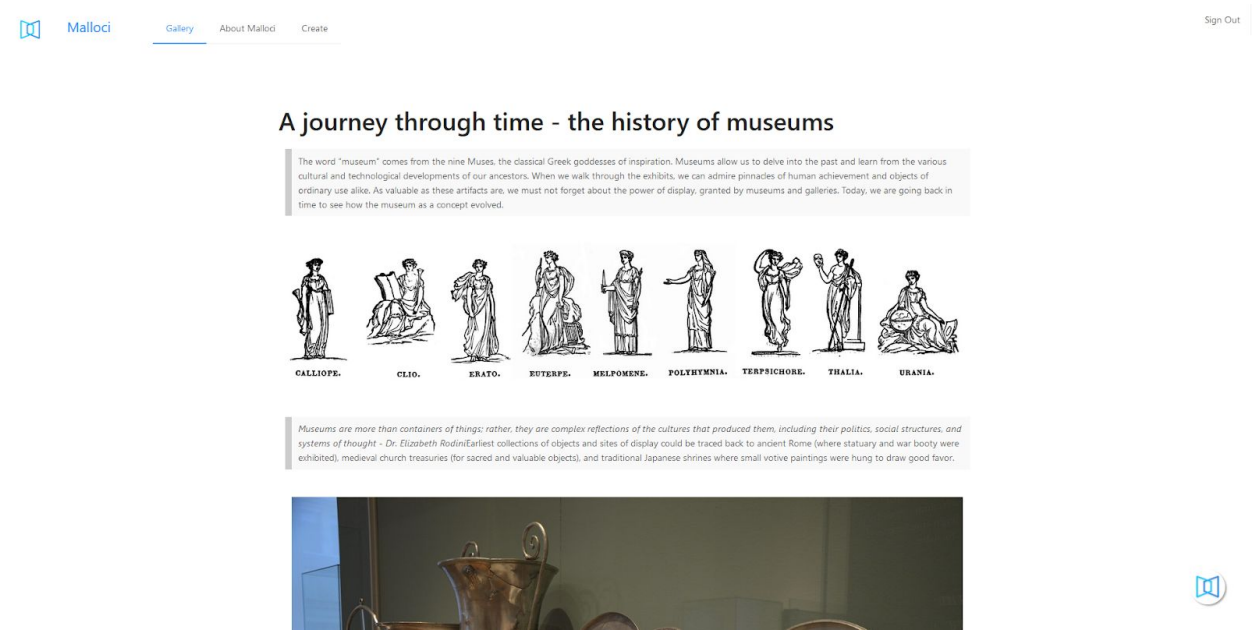
Prototype implementation

The prototypical implementation of Malloci took form as a web application, hosted here, that serves the twofold purpose of being a gallery of exhibits that serves as inspiration and repository for creators, and a what-you-see-is-what-you-get web editor to create and edit exhibits.

The gallery (fig. below) is a curation of articles written in markdown and uploaded using the publish function in the editor. These can be viewed as both documents and VR exhibits by anyone visiting the site.

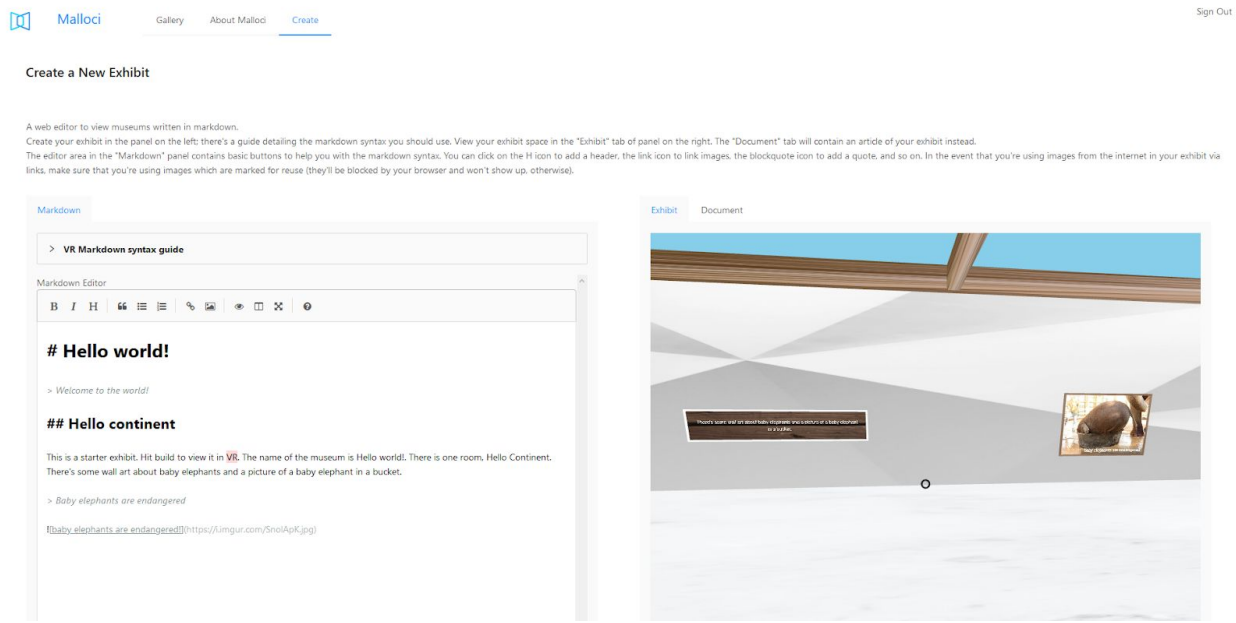


Selecting a museum to view will open that museum's document view (fig. below), and the user can switch to viewing the museum in VR by clicking on the Malloci floating icon at the bottom right.



The museum can be viewed in-browser (fig. below), or using a VR headset. When viewing exhibits in webVR, the user navigates through the space using their mouse and keyboard. This museum on museums (fig below) is utilizing custom theming and has ambient audio.

Under the “create” tab (or “playground”, when not signed in) is an editor that is populated with a placeholder museum. Articles in the “markdown” tab can be viewed in VR in the “Exhibit” panel alongside (fig below).



They can also be viewed as the equivalent markdown document in the “Document” panel (fig below).

links, make sure that you're using images which are marked for reuse (they'll be blocked by your browser and won't show up, otherwise).

Markdown

> VR Markdown syntax guide

Markdown Editor

Hello world!

> Welcome to the world!

Hello continent

This is a starter exhibit. Hit build to view it in VR. The name of the museum is Hello world!. There is one room, Hello Continent. There's some wall art about baby elephants and a picture of a baby elephant in a bucket.

> Baby elephants are endangered

![baby elephants are endangered!](https://i.imgur.com/SnoIApK.jpg)

lines: 11 words: 66 0.0

Upload

Build

Exhibit Document

Hello world!

Welcome to the world!

Hello continent

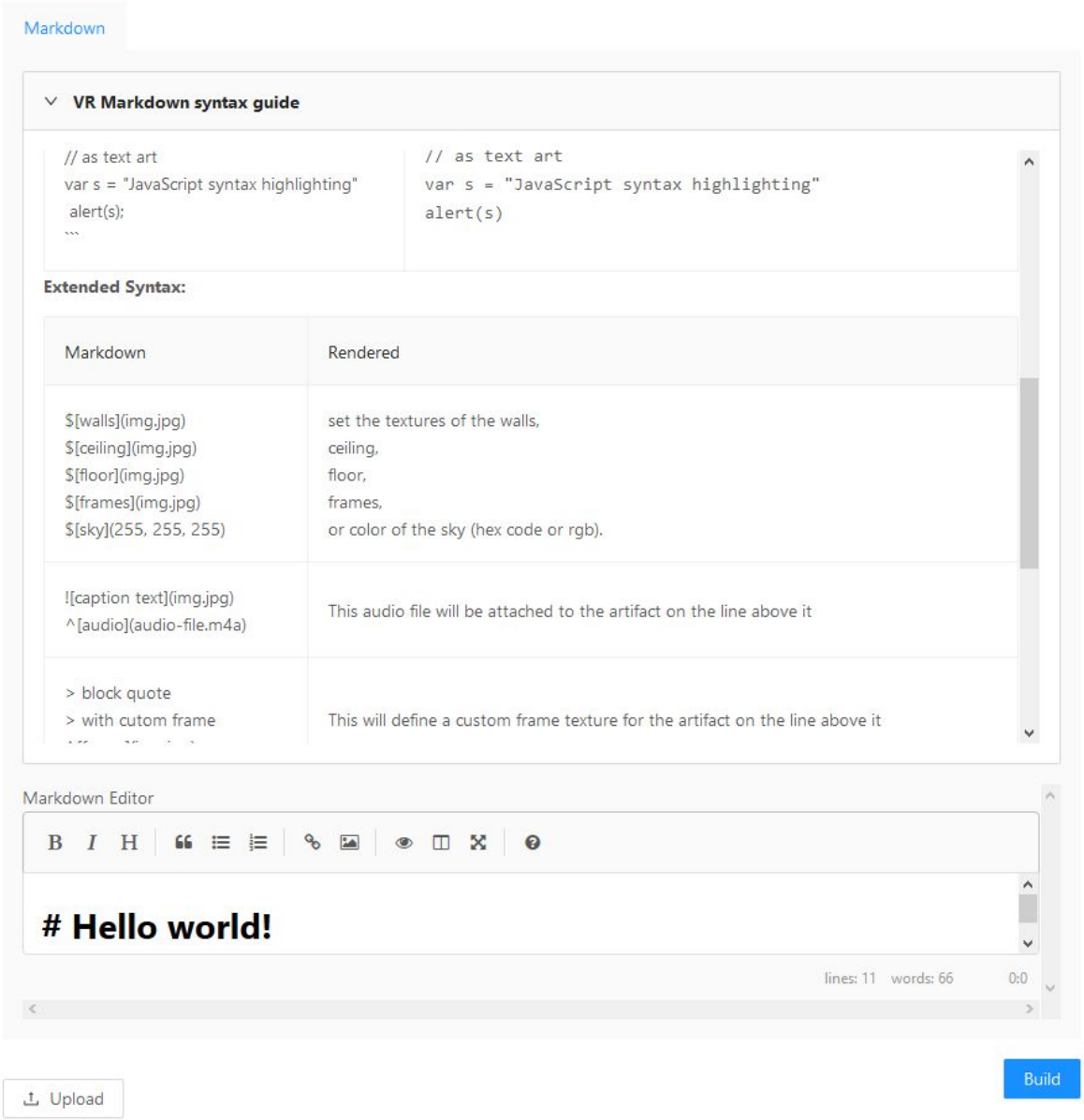
This is a starter exhibit. Hit build to view it in VR. The name of the museum is Hello world!. There is one room, Hello Continent. There's some wall art about baby elephants and a picture of a baby elephant in a bucket.

Baby elephants are endangered

Publish

Additionally, prior to building, and before syntax is parsed by the Malloci engine, the document can be previewed in traditional markdown formatting alongside the raw markdown using appropriate toggles.

Meant as a platform to facilitate the creation of museums with minimal effort, and no prior knowledge of writing in markdown, the markdown editor space comes equipped with a guide to traditional markdown syntax and the extended syntax Malloci uses (fig below), in addition to basic GUI buttons that insert text formatting, links, images and audio.



Built as a React application with Firebase integration, the editor allows users authenticated via their berkeley.edu email addresses to upload ("publish") their museums to the gallery. Published exhibits can be edited by the publisher and shared as both an exhibit and a markdown document. This restriction was put in place to both hold museum creators accountable for content they were publishing using Malloci as well to keep Firebase hosting costs reasonable.

Text and Language Processing

The Malloci editor allows users to submit plain text with no MarkDown formatting to their exhibit documents. Any text entered into the Malloci system that is not wrapped

in MarkDown syntax is sent to our backend Artifact Generator (AG) where it is automatically parsed and used to generate additional artifacts. The rationale for this feature was to enable users with virtually no MarkDown experience to successfully engage with the tool. The Artifact Generator offloads the onus of proper MarkDown syntax away from the user, freeing them up to focus on creating content rather than formatting.

The goal of the AG is to return a limited set of artifacts that successfully summarize the input text. It aims to achieve maximal compression, while optimizing for informativeness of the output. The AG accepts a Museum JSON structure (see Appendix) as input, and returns an updated Museum structure containing additional text-based artifacts. At the moment, the generator is hosted on Google cloud platform.

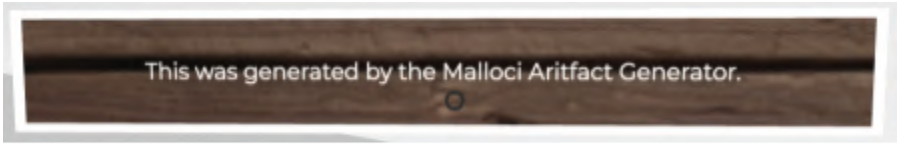
Considerations

In the early stages of development, we surveyed related approaches to text visualization, summarization, and keyphrase extraction. This section briefly outlines the considerations that went into the design and development of the Artifact Generator.

Text Visualization

Text visualization is challenging. While text visualization is an active area of research [3,4,15], most existing approaches to text visualization struggle to communicate information efficiently. Perhaps the most notorious visualization in the text viz community is the *word cloud*. Though visually compelling, word clouds have been shown to be ineffective in document representation due to ambiguous sizing, color, and spatial placement of words [5,7,14].

In order to keep the exhibit experience intuitive and familiar, we chose to limit the AG output to unaltered token sequences extracted directly from the input text, to be framed and displayed in the exhibit with custom styling.



A text-based artifact rendered in Malloci

Keyphrase Extraction

Various frequency-based keyword extraction methods such as unigram bag-of-words counts counts and TF-IDF scores are effective in identifying the most salient words in

a document. Keyphrase extraction extends these approaches by extracting meaningful multiword phrases that are more descriptive and informative, especially in the context of text visualization [2]. Keyphrase extraction is generally achieved by defining part-of-speech grammars to match and extract noun phrases such as "health care" or "united states" [6].

Ranking Algorithm

At the core of the Malloci Artifact Generator is a sentence ranking system that identifies and returns the most salient sentences in a document. We formulated the goal of the AG as a sentence extraction task: given an input document, the generator returns a limited set of sentences.

We draw from existing work in frequency and graph-based summarization systems [10,11]. We chose to develop our own implementation rather that using existing libraries like Sumy[1] to allow for further customization, reduce our dependence on external libraries, and also keep the option of moving the parser client-size open. We rely on the Spacy[2] NLP processing python library for sentence and word tokenization, named entity recognition and part of speech tagging.

Our ranking algorithm closely mimics SumBasic [11] and is motivated by the observation that words that occur more frequently in a document are more likely to appear in human summaries of the document. Thus, sentences containing these words should have a higher probability of being displayed in the Malloci exhibit. We implement a simple ranking algorithm as follows:

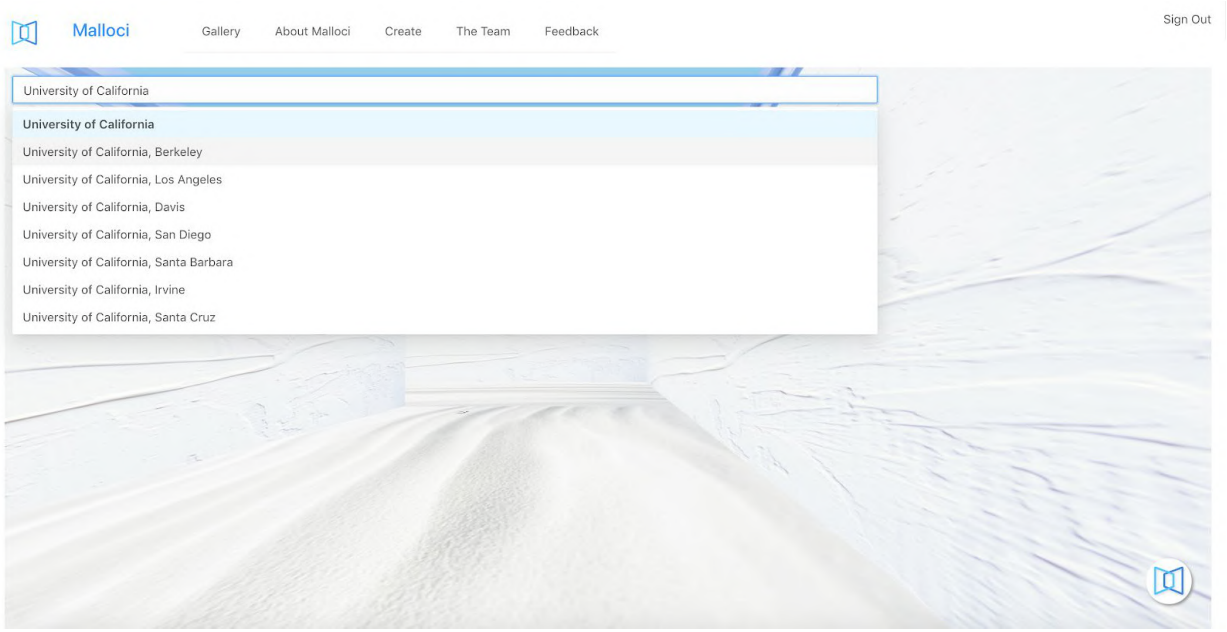
1. Tokenize each sentence S_i. Group named entity spans.
2. Calculate the number of occurrences of each non-stop token in the document, normalized by total token count.
3. Rank all sentences in the document in descending order of the average weights of tokens in each sentence.
4. Return the top N highest scoring sentences to their original order to form a summary of the document.

Finally, we use the python implementation[3] of Phrasemachine [6] to identify keyphrases in the extracted summaries and use CSS styling to visually differentiate them from the rest of the rendered text in the exhibit.

[1] https://pypi.org/project/sumy/
[2] https://spacy.io/
[3] https://github.com/slanglab/phrasemachine

Wikipedia Parser

Similar to other content creation platforms, Malloci requires active community participation for the generation of exhibits. Harnessing the massive amount of content already available online, we implemented a wikipedia parser that enables users to search for and experience Wikipedia articles in VR on the Malloci website. Our custom Wikipedia parser is implemented in JavaScript and runs client-side. We utilize the Media-Wiki API[4] to search and download wikipedia pages before parsing them into MarkDown, which is rendered into exhibits by the Malloci Engine.



Searching items in Malloci Wikipedia Parser

User Research and Usability testing

Usability testing is important to observe how users interact with the prototype before a final product launch. It provides a method of ensuring that the behaviours exhibited during interaction align with the developers' intention.

During this test, actions and reactions such as eye movement, navigation, text readability and spatial interpretation will be observed, with the aim of developing better understanding around user behaviour in a VR environment and making improvements to the tool where necessary. Observations will also be made on the usability of the markdown tool and parsing markdown files into the exhibit. Users are expected to be able to create, upload and render WebVR content using the

[4] https://www.mediawiki.org/wiki/API:Main_page

markdown tool, with as minimal supervision as possible. Since Malloci is intended for use by anyone who has an interest in VR content, these series of tests will provide a sense of how well users can understand the tool irrespective of experience or inexperience with the world of Virtual Reality.

Another goal for testing is adaptability. The environment should be adaptable to most kinds of VR headsets ranging from a basic cardboard headset to a sophisticated headset such as the Samsung VR or the Oculus. Also, users should be able to render content using smartphones with certain specifications and this test will involve consistency checks for these devices.

Unfortunately at the time of writing this report the user testing for this tool had not been carried out due to the COVID-19 pandemic, as in-person testing is required. However, tremendous progress has made through iterative usability testing among the creators of Malloci. Through this we discovered incidental capabilities of this tool, beyond what we had initially expected or realised. For future purposes, a detailed guideline on the proposed process of user testing is attached in the appendix section of this report.

Discussion and Future Work

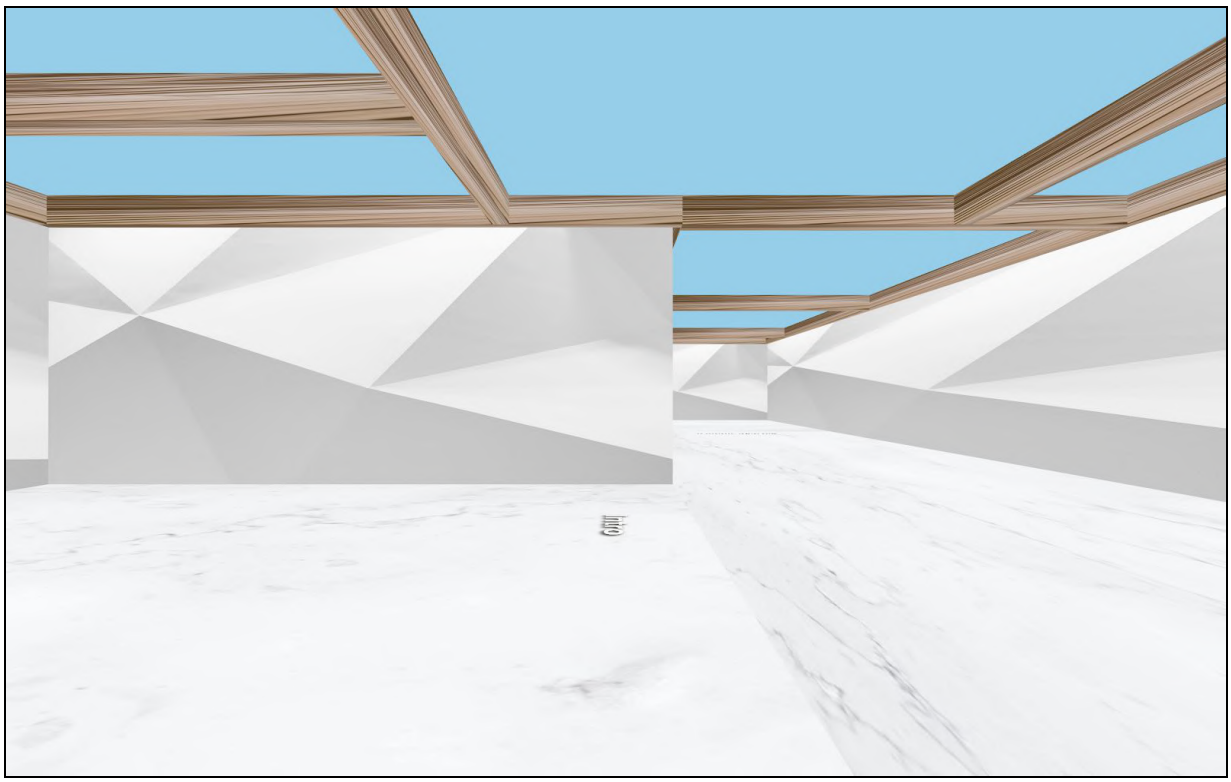
The goal of this project was to develop a more approachable method to Web-based VR content creation. While we are satisfied with the realisation of that goal, we believe that there are a number of unexplored possibilities and applications for this solution. Ultimately we see this as a new way of consuming information, a way for users to slow down and more actively engage and explore the content. Further studies should be done on how well users retain and understand information gained through virtual exhibition in comparison with traditional web formats.

Ideas for future developments could include enabling multi-user experiences, support for 3D model and video artifacts, room specific theming, in-exhibition linking, and dynamic space rendering in order to support larger scale exhibits.

Appendix

Style Guide

Default Space Style



Default Space

Default Frames

Wood Theme (First Iteration)

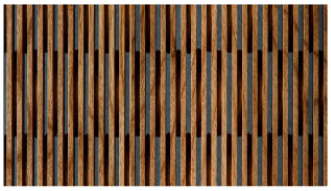
Primary Color

Background, Wallpaper, Ceilling, Floor, Pedestals...

#705947 #d7bd98 #f4f2d7 #4f5556 #3b1b12

Wallpaper & Walls

Linear, seamless, wood



Frame

hexagon, black frame, could be different sizes, attached or detached

Secondary Color

Signs, Text, Accessories...

#215b33 #f2ce68 #e87511 #30383a #fef1e1

Floor

Light, pale, wood

Pedestal

Naturally carved, asymmetrical, geometry, wood

Typography

Montserrat, Regular, SemiBold, Bold

Malloci

Malloci

Malloci

Malloci

MALLOCI

Ceiling

partial transparent ceiling with wood

Lighting

natural light coming from window, only light up objects

White Theme (First Iteration)

Primary Color

Background, Wallpaper, Ceilling, Floor, Pedestals, Frames...

#FEFEFE #E7E4E1 #848080 #322D33 #997E3B

Wallpaper & Walls

Background:
pure white

Walls:
white polygonal patterns

Pedestal

Material: silver, bronze or gold
Shape: half sphere, could be different in size
Goal: to display 2D images

Material: glass
Shape: rectangular prism with two sides open
Goal: to display 3D objects

Secondary Color

Signs, Text, Accessories...

#535657 #B7ADCF #DEE7E7 #4F646F #F4FAFF

Floor

Texture: white marble

Frame

Material: hanging string, thick paper
Shape: rectangular
Goal: to display 2D images and text

Material: white frame
Shape: rectangular
Goal: to display 2D images and text

Typography

Poppins, Regular, SemiBold, Bold

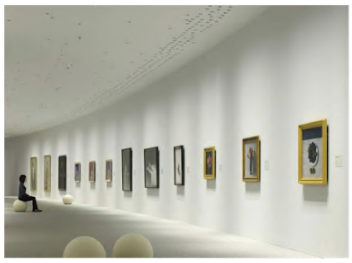
Malloci
Malloci
Malloci
Malloci
MALLOCI

Ceiling

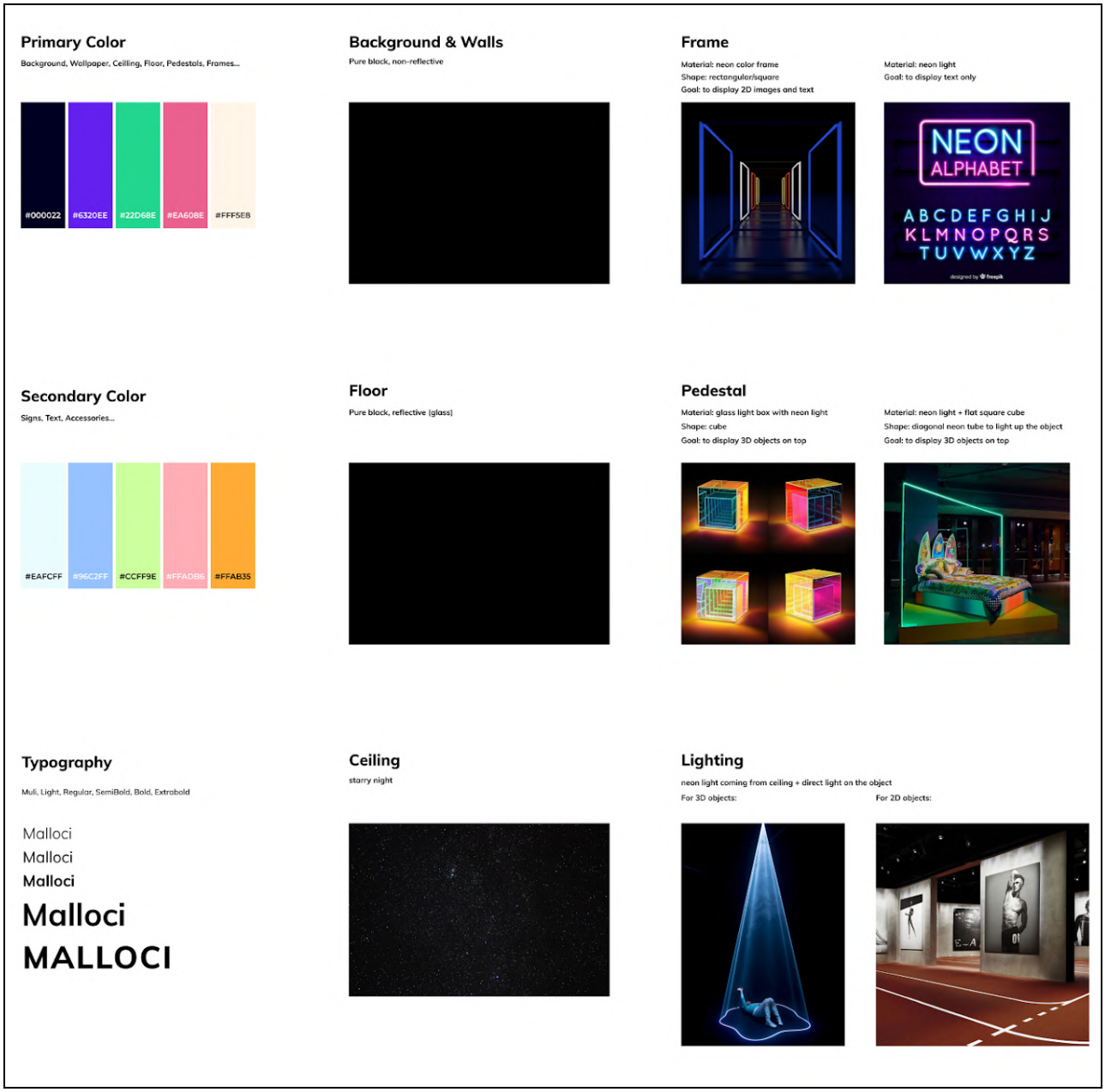
semi transparent ceiling with patterns

Lighting

natural light coming from ceiling + direct light on objects



Dark Theme (First Iteration)



User Testing Plan

A detailed user testing plan for Malloci is linked here (https://rb.gy/z4b4kd). Feedback Survey is also available on our website for anyone to post their feedback

VRMD parser: JSON structure

Museum:

```
{
    "name": "Malloci - WebVR for the People",
    "theme": {
        "floor": null,
        "walls": null,
        "ceiling": null,
        "frames": null,
        "sky": null
    },
    "rooms": [...]
}
```

Room:

```
{
    "name": "Malloci - WebVR for the People",
    "text": "...",
    "artifacts": [...]
}
```

Artifacts:

```
{
    "type": "image",
    "audioSrc": "description.m4a",
    "frameSrc": null,
    "src": "val.jpg",
    "alt": "This is my dog."
},
{
    "type": "block quote",
    "audioSrc": null,
    "frameSrc": null,
    "text": "This is a block quote"
},

{
    "type": "code",
    "audioSrc": null,
    "frameSrc": "path/to/texture.jpg",
    "text": "print(\"Hello world\")"
}
```

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