Get Inspired by Museum Online Collections

TU Delft

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Master Thesis
Design for Interaction

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Executive Summary

Art is the universal language of humanity. Art viewing not only evokes aesthetic pleasure but also inspires people to create their own art. In this digital age, more and more museums democratize their art by making their digital collections freely available online. However, these online sources are mainly targeted at researchers and visit planners who have specific search goals in mind. For inspiration-seekers who usually start with a vague idea, the current way of access to museum digital collections–searching through metadata–limits their exploration.

This graduation project explored how to help novice artists seek inspiration in museum online collections. Through literature review into the topics of inspiration and creativity and interviews with creatives, an understanding of the context was gained. The user study revealed that museum digital collections are more valued by beginner artists. The design goal and target group were narrowed down for the following ideation phase. Three interaction qualities, guiding, resonating and encouraging were used as guidance through the exploration.

Based on the insights gathered from the field research, four rapid prototypes were developed and tested with seven participants to define the final design direction. In addition, the interface of the chosen prototype was redesigned to enhance its usability.

The final concept, ArtMind, is an online tool that allows users to make textual associations to diverge their ideas while also recommending them similar artworks to converge ideas. The final design consists of three core functions:

1. Associated search
2. Recommending artworks with similar visual characteristics
3. Making personal collections

Finally, user testing allowed me to evaluate to what extent my design solution achieves the design goal. Participants claimed that ArtMind offers a unique inspirational path. By broadening their thinking pathways, they were able to generate more original ideas.

Glossary

API
An application programming interface that makes the data available for sharing and allows computer programs to communicate with each other.

Artificial Intelligence
Artificial intelligence is a wide-ranging field of computer science with a focus on building smart machines that can perform tasks that traditionally require human intelligence.

Confidence score
This score demonstrates the probability that the algorithm successfully identified the object

Machine Learning
It is a type of AI that uses large sets of data to train its systems. It can effectively learn the patterns in the data and make predictions of outcomes with that data.

Neural network
A subset of machine learning that mimics how the human brain works to identify underlying relationships in a data set.

Object Metadata
Data that describes the art object, providing a structured reference that helps to sort and identify attributes of the artwork. Examples of metadata are title, genre, artist, period, etc.

Object number
The unique code of each artwork in Rijksstudio

User-sets
User generated art collections in Rijksstudio

Table of Contents

1 Project Overview

This chapter covers a general overview of the project. The context of the project is explored through literature research. Finally, the design approach of this project will be explained.

1.1 Context

[1] Reference
Ishiguro, C., & Okada, T. [2020]. How Does Art Viewing Inspires Creativity? *The Journal of Creative Behavior.* https://doi.org/10.1002/jocb.469

"*Good artists copy, great artists steal.*"

Pablo Picasso was making a point about how great artists and good artists approach their job differently. Good artists try their best to closely emulate [copy] the work of others. Great artists, on the other hand, carefully select [steal] components from numerous sources and creatively mix them to create something that retains its own uniqueness.

Vincent van Gogh made copies of artworks of his favorite artists, such as Eugène Delacroix, Jean-Francois Millet and Rembrandt. Rather than replicate, he infused his own originality with new art techniques and symbolism into the painting [Figure 2]. Similarly, it is apparent that 'Portrait of Young Woman with Unicorn', a painting made by Raphael was made based on the composition of the Mona Lisa. It is asserted that art viewing inspires people to create artworks [1].

Figure 1. *Noonday Rest by Jean-Francois Millet*

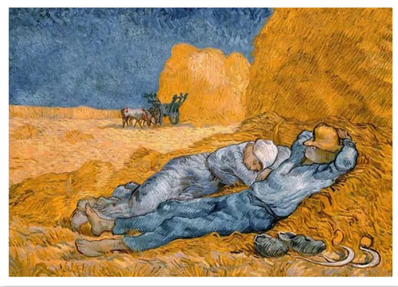


Figure 2. *Noon Rest from Work by Vincent van Gogh*

Values of Art Reproduction

In the age of mechanical reproduction, photography became a suitable replacement for original artworks. Since photos can be brought everywhere, it became possible to compare artworks and evaluate different artists and periods of art. André Malraux, a French philosopher, argued that the ease of comparison and analysis has expanded our understanding of the worth of art [2]. Based on this philosophical view of art, Malraux came up with the idea of 'museum without walls'. In his book *Le Musée Imaginaire*, it is described as:

"*An imaginary museum that exhibits all of the world's greatest art under one roof, free of geographical constraints.*"

Photographic reproduction of art presents a solution to this idea.

Digital reproduction

Nowadays, it has been a common practice to view the reproduction of art. Computers and the internet offer the possibility to achieve the concept of 'museum without walls'. More and more digital reproductions of art are available online. A survey in 2020 showed that 43.6% of European museums' collections are digitized [3].

According to Brad [2005], the advantage of digital collections is the flexibility to view and study materials in a way that best matches users' preference. Digital copies of artifacts or exhibits can be accessed anytime, anywhere. It keeps a near-complete record of the item that can be retrieved without harming the original [4]. However, digital art reproductions cannot completely replace the original. One study demonstrated that original paintings enhance the emotional response and the desire to touch the works more than their digital reproductions. On the other hand, there are no significant differences in the color intensity, perceived movement and aesthetic value between digital and original artworks [5]. As a result, online viewers can still get inspired by digital art collections in the terms of color, movement and aesthetic.

[2] Reference
Savedoff, B. E. [1993]. Looking at Art through Photographs. *The Journal of Aesthetics and Art Criticism*, 51[3], 455. https://www.jstor.org/stable/431517

[3] Reference
Final report Digitisation and IPR in European Museums. [2020]. https://www.ne-mo.org/fileadmin/Dateien/public/Publications/NEMO_Final_Report_Digitisation_and_IPR_in_European_Museums_WG_07.2020.pdf

[4] Reference
Hemminger, B., Bolas, G., & Schiff, D. [2005]. Capturing Content for Virtual Museums: from Pieces to Exhibits. *Journal of Digital Information, 6[1].* https://jodi-ojs-tdl.tdl.org/jodi/article/view/jodi-162

[5] Reference
Siri, F., Ferroni, F., Ardizzi, M., Kolesnikova, A., Beccaria, M., Rocci, B., Christov-Bakargiev, C., & Gallese, V. [2018]. Behavioral and autonomic responses to real and digital reproductions of works of art. Progress in Brain Research, 201–221. https://doi.org/10.1016/bs.pbr.2018.03.020

1.2 Digital Museum Collections

The concept of a "virtual museum" flourished along with the development of the Internet. In the *Britannica Online* a virtual museum is defined as:

"*A collection of digitally recorded images, sound files, text documents, and other data of historical, scientific, or cultural interest that are accessed through electronic media.*"

Virtual museums, or digital museums have been seen as an extension of their physical sites. They opened up art to audiences who might not have visited the museum. Museums' online collections and exhibitions offer new opportunities to attract physical visitors while also strengthening the relationship between museums and their audience [6]. Masterpieces that are promoted by museums online attract people to see them in real. Besides, it solves the issue of physical space limitations for exhibiting all of the museum's collections. At the same time, museums face the challenge to fulfill online users' different needs with their museum websites. Online users would like to have a unique experience that is not available in physical museums [7].

Among digital museums, Rijksstudio stands out due to its discovery-based interface and encouragement of creativity [8]. Rijksstudio is an extented website of Rijksmuseum, the national museum of the Netherlands. In 2013, Rijksmuseum launched its Open Data Policy by offering its digitized museum collections [10]. Currently, more than 700,000 digitized artworks are published on the Rijksstudio website, free of copyright. In addition, the Rijksmuseum has an API [Application Programming Interface] that enables any programmer to freely retrieve digital images, descriptive object information [metadata], and bibliographic data.

Rijksstudio was created for creativity. In contrast to most digital museums' text-based interface, Rijksstudio has its 'image first' strategy to reach a wider audience [9]. Rijksmuseum started a biennial international design competition called Rijksstudio Award in 2014. The public is encouraged to use the Rijksmuseum collections as inspiration for their works in this competition.

In this part, Rijksstudio is used as an example for analyzing the functions of a digital museum.

[6] Reference
Cameron, F. [2003]. Digital Futures I: Museum Collections, Digital Technologies, and the Cultural Construction of Knowledge. *Curator: The Museum Journal, 46[3],* 325–340. https://doi.org/10.1111/j.2151-6952.2003.tb00098.

[7] Reference
Marty, P. F. [2008]. Museum websites and museum visitors: digital museum resources and their use. *Museum Management and Curatorship, 23*[1], 81–99. https://doi.org/10.1080/09647770701865410

[8] Reference
Drotner, K., Dziekan, V., Parry, R., & Schrøder, K. C. [2018]. *The Routledge Handbook of Museums, Media and Communication* [K. Drotner, V. Dziekan, R. Parry, & K. C. Schrøder, Eds.]. Routledge. https://doi.org/10.4324/9781315560168

[9] Reference
P. Gorgels, Rijksstudio: Make Your Own Masterpiece!. In *Museums and the Web 2013*, N. Proctor & R. Cherry [eds]. Silver Spring, MD: Museums and the Web. Published January 28, 2013. Consulted September 19, 2022 . https://mw2013.museumsandtheweb.com/paper/rijksstudio-make-your-own-masterpiece/

Rijksstudio has four main pages. Each of the pages contains a number of features designed to meet the various user needs.

Home page

Firstly, users can find the highlights of the museum on the homepage, such as famous paintings and popular art categories and art themes. Besides, Rijksstudio shows some user-created collections of artworks to make the content of the home page richer. There is also a pop-up window at the bottom to invite online visitors to book a museum visit.

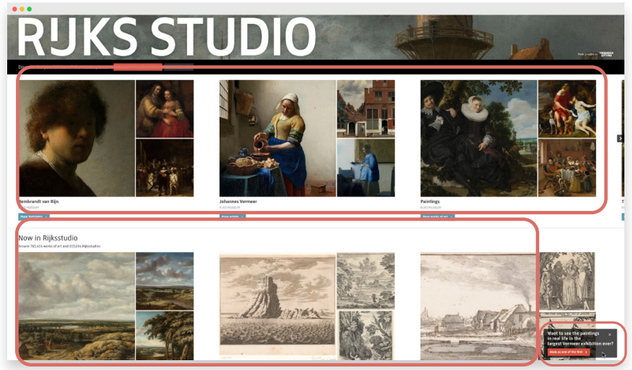


Figure 3. Screenshot of Rijksstudio's home page

Search page

Online users can search a specific art object through metadata, such as artist name, object type, period, place, etc. The search results can be ordered by relevance, chronological order, artists in alphabetical order or objectnumber in alphabetical order. In addition, there are also advanced search functions for research related searches.

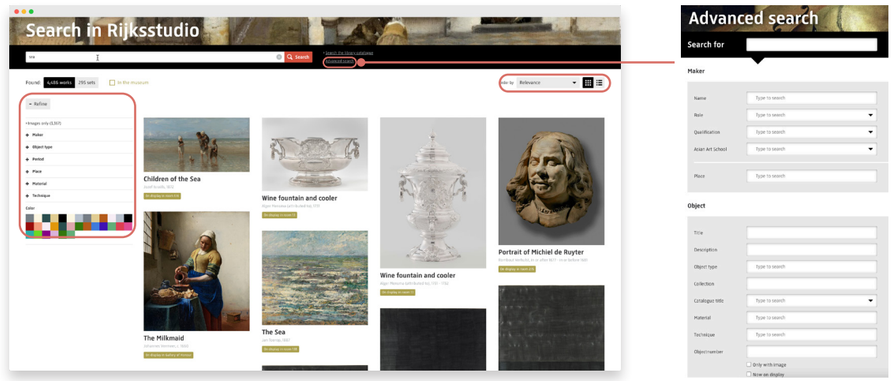
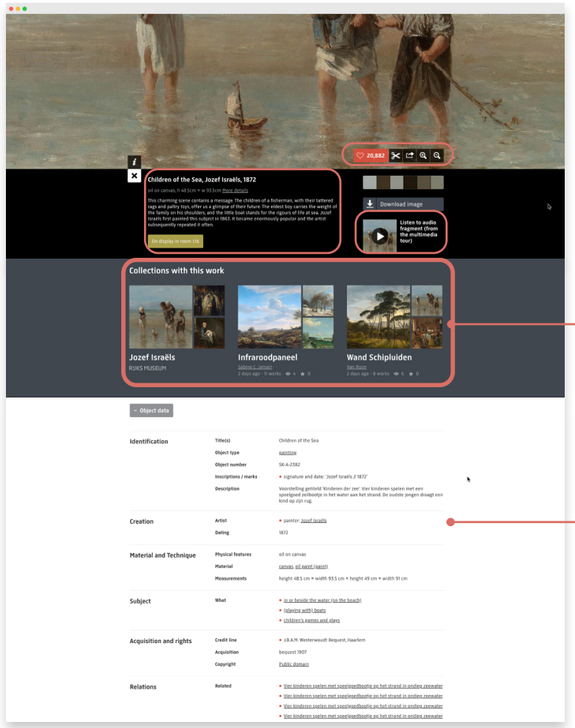


Figure 4. Screenshot of Rijksstudio's search page

[10] Reference
Van Thoor, M. T. A., & Meurs, P. H. [2013]. Introduction: Towards the new Rijksmuseum. *Rijksmuseum Amsterdam: Restoration and transformation of a national monument.* http://resolver.tudelft.nl/uuid:c6a1c490-d25d-4185-9cc5-5239f6c1e51c

Information page

On the information page, there is in-depth information about the artwork including artist name, period, whether it is on display in the museum, accompanying description and audio explanation. Images can be saved to personal collections, cropped and downloaded in high resolution, shared on social media, or enlarged.



In addition, Rijksstudio shows some user-sets below the artwork to suggest other pieces of art that might be of interest to the user.

More metadata of the artwork, such as material and techniques, references, and links to further readings are presented below the image.

Figure 5. Screenshot of Rijksstudio's information page

Personal collections

Not only in Rijksstudio, but in more and more online libraries, archives, and museums, users have the option to make their own collections of digital resources that are meaningful to them. The available functions are: bookmarking specific pieces, making annotations, storing personal collections online for future use, and sharing with others [11].

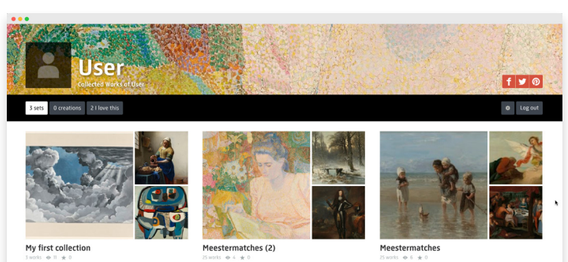


Figure 6. Screenshot of Rijksstudio's personal collections page

[11] Reference
Marty, P. F. [2011]. My lost museum: User expectations and motivations for creating personal digital collections on museum websites. *Library & Information Science Research*, 33[3], 211–219. https://doi.org/10.1016/j.lisr.2010.11.003

1.3 User segments

The study of Villaespesa [2019] defines six segments of users of online collections [12]. They are professional researcher, personal interest information-seeker, student researcher, inspiration-seeker, casual browser, and visit planner. In this section, I will take a deeper look into different types of users and analyze to what extent current museum interfaces fulfill their needs.

[12] Reference
Villaespesa, E. [2019]. Museum Collections and Online Users: Development of a Segmentation Model for the Metropolitan Museum of Art. *Visitor Studies*, 22[2], 233–252. https://doi.org/10.1080/10645578.2019.1668679

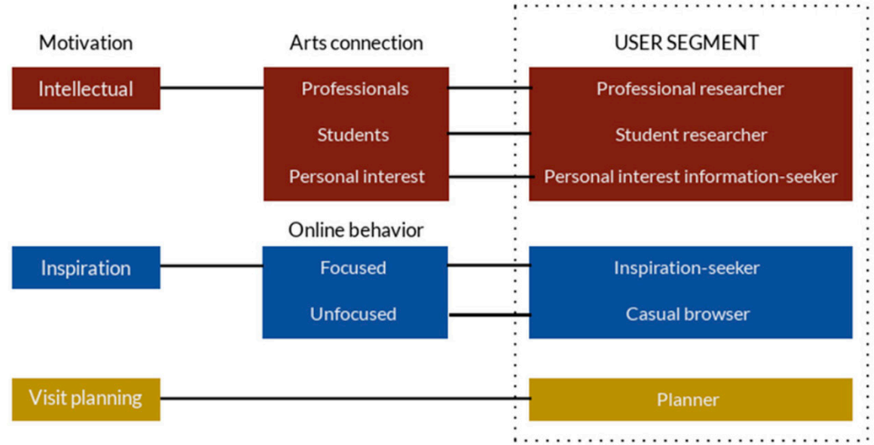


Figure 7. Segments of online visitors [12]

Intellectual

Nearly 60% of the online users come to the museum website to learn about art. Intellectually motivated users can be split into three groups of people, professional researchers, student researchers and personal interest information-seekers, based on their preferred information.
Professional researchers usually use **advanced search functions** since they have an in-depth understanding of the subject. Student researchers visit museum websites for conducting research for their studies. Their needs are met by the search functions and the **information page** of an art object. Personal interest information-seekers are those who visited the museum in person and are interested in learning more about their favourite

exhibits. They usually conduct searches through keywords, such as artists' names, art movements and themes. They value additional information connected to the art object.

Inspiration

Results of the survey revealed that 34% of the online users visit museum websites for getting inspired by the art. This category of users can be divided into two groups, inspiration-seekers and casual browsers, based on their online behaviours. Inspiration-seekers are artists, art hobbyists and those who search art images for stimulating their creativity. They usually **search** for particular topics, and they use **filters** when browsing the collections. Casual browsers visit museum websites for an inspirational visual experience. They will only stay on the website if the images on the page are appealing to them. In comparison with inspirational-seekers, casual browsers do not have a specific purpose while browsing the website.

Visit planning

The last category is the visit planners. They are curious about what they might see in the museum. The **highlights** on the homepage of the museum website are what they like to browse.

1.4 Design challenges

Current ways of access to museum online collections such as searching through metadata and browsing the homepage, could be useful for researchers and visit planners because they visit the collections with specific goals. However, while searching for inspiration, the search purpose might be vague, and the searcher might not be familiar with certain terminologies [13].

Finding inspiration starts by searching for stimuli, selecting, retrieving, and then integrating those stimuli into a context [14]. Search forms the most important part of the inspirational process. The search behaviour can be divided into exploratory and specific search. Exploratory search frequently leads to unexpected results, while specific search is conducted intentionally for gathering specific information. Ideally, both exploratory and specific search methods should be available for creative people [15].

Other ways of access to museum online collections are usually neglected since the search function is so effective [16]. Text-based search can cause semantic deviation which limits discovery, while searching through sketching gives users more direct output [17].

Browsing is the most close alternative to search. However, the search results are usually presented in an uninspired way: a ranked list of images. Instead of being an input-output exchange, it should provide an open-ended experience.

Museums ignored one user segment: people who seek creative inspiration. Creatives value museum collections as a source of inspiration. However, current ways of access, such as searching through keywords and browsing the highlights, are limiting the possibilities for them to explore online collections.

This project aims to explore new ways of access to museum online collections. The described design gap results in the following research question:

How to help creatives seek inspiration in museum online collections?

[13] Reference
Kules, B. (2005). Supporting creativity with search tools. *Creativity Support Tools*, 50, 53-64. http://www.cs.umd.edu/hcil/CST

[14] Reference
Goncalves, M. G. (2016). Decoding designers' inspiration process. https://doi.org/10.4233/uuid:a270cdf2-d46b-4085-8f4f-328b823ccdee

[15] Reference
Sutcliffe, A., Ennis, M., 1998, "Towards a cognitive theory of information retrieval," *Interacting with Computers, 10*, pp. 321-351. https://doi.org/10.1016/S0953-5438(98)00013-7

[16] Reference
Whitelaw, M. (2015). Generous Interfaces for Digital Cultural Collections. *Digital Humanities Quarterly, 009*(1). http://www.digitalhumanities.org/dhq/vol/9/1/000205/000205.html

[17] Reference
Kwon, E., Huang, F., & Goucher-Lambert, K. (2021). Multi-Modal Search for Inspirational Examples in Design. *Volume 6: 33rd International Conference on Design Theory and Methodology (DTM)*. https://doi.org/10.1115/detc2021-71825

1.5 Existing technology

Google did a number of Arts & Culture Experiments to help museums integrate new technologies with the current websites. These experiments are created to increase the engagement of users to the museum's online collections. In order to gain a better understanding of current technology and possibilities, the existing Arts & Culture Experiments were studied. The following four categories were made based on their functions:

1. Visual connections between art objects

Experiments in this category try to connect different pieces of art based on their visual similarities, such as colors, patterns, shapes or elements.

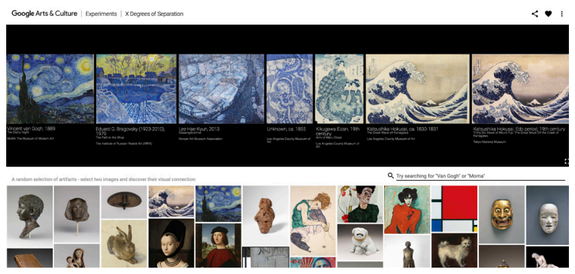


Figure 8. Examples of the experiments that connect different artworks [18]

[18] Reference
X Degrees of Separation: https://experiments.withgoogle.com/x-degrees-of-separation

Beyond Scrolls & Screens: https://experiments.withgoogle.com/beyondscrolls

2. Arrangement of artworks

Examples of this category of experiments are displaying artworks in a three dimensional space, laying out the artworks on a table, creating an 3D interactive landscape with artworks and mapping the artworks on a time line (Figure 9).

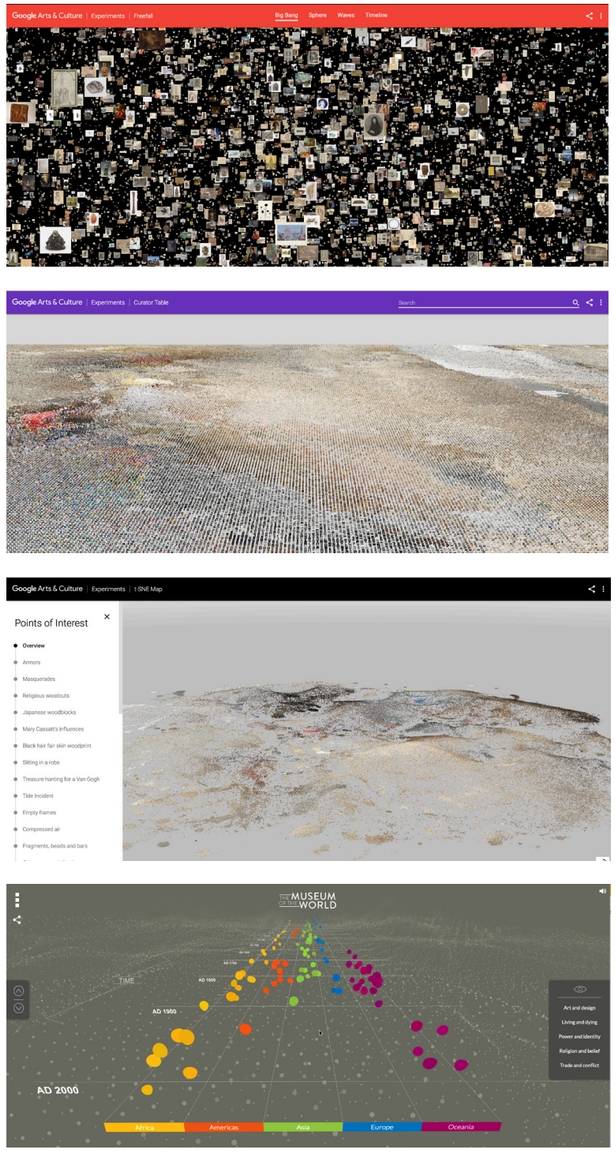


Figure 9. Examples of the experiments that present artworks in interactive ways [19]

[19] Reference
Freefall: https://experiments.withgoogle.com/free-fall

Curator Table: https://experiments.withgoogle.com/curator-table

t-SNE Map: https://experiments.withgoogle.com/t-sne-map

The Museum of the World: https://experiments.withgoogle.com/the-museum-of-the-world

3. Creative ways of user input

Different ways of user input are experimented by Google Art & Culture. Some examples of the user input are: customized color palette, users' drawings, users' movements and camera feed.

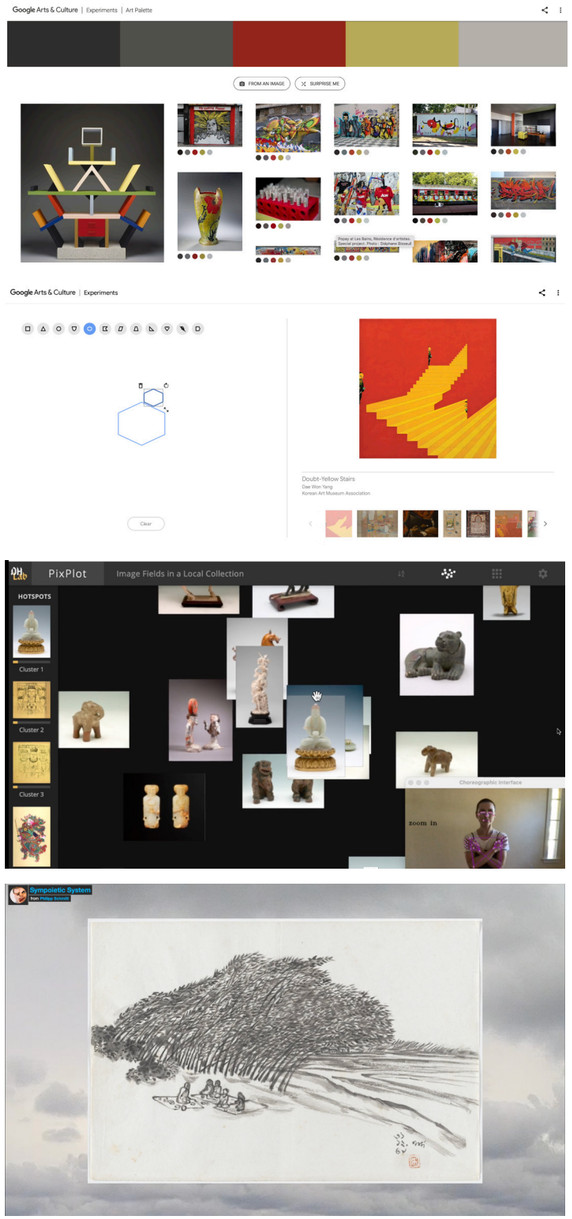


Figure 10. Examples of the experiments that explore different ways of user input [20]

[20] Reference
Art Palette:
https://experiments.withgoogle.com/art-palette

Draw to Art:
https://experiments.withgoogle.com/draw-to-art-shape

Choreographic interface:
https://metalabharvard.github.io/projects/curatorial-aigents/surprisemachines/

Weather as curator:
https://mlml.io/p/sympoietic-system/

4. Gamification

The experiments of the category are aimed to engage users by making art exploring experience as a game.

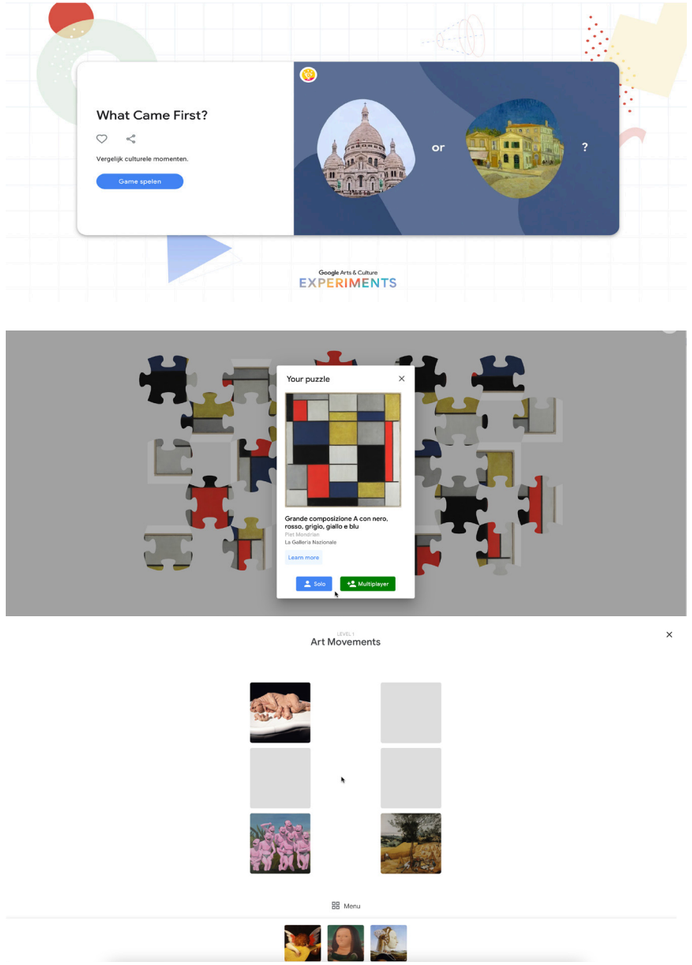


Figure 11. Examples of the experiments that gamify the art exploring experience [21]

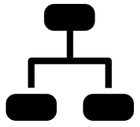
[21] Reference
What came first:
https://experiments.withgoogle.com/what-came-first

Puzzle Party:
https://experiments.withgoogle.com/puzzle-party

Visual Crosswords:
https://experiments.withgoogle.com/visual-crosswords

The tools that are used for each cluster are listed in the next page. These could be used as inspiration in the ideation phase.

Overview of used tools



Visual Connections

- **Similarity Machine Learning [22]**
  This type of machine learning uses a Nearest Neighbor method [23] to determine how similar two or more images are to each other through algorithmic distance functions.

- **Google Vision AI [24]**
  It assigns labels to images and classifies them into millions of predefined categories.

Analysing User Input

- **Quick, Draw! [25]**
  A dataset which contains 50 million drawings across 345 categories. The drawings were captured as timestamped vectors and tagged with metadata. This dataset can be used for training a drawing classifier that recognises users' sketches.

- **Hand Pose Detection [26]**
  For each hand, it predicts the handedness (left or right) and an array of keypoints of the hand.

- **Javascript palette extractor [27]**
  It takes an image as input and returns an array of RGBA values of the image's color palette.

[22] Reference
dzlab. (2019, February 2). *X Degrees of Separation with PyTorch*. X Degrees of Separation with PyTorch. https://dzlab.github.io/dl/2019/02/02/X-Degrees-Separation/

[23] Reference
What is the k-nearest neighbors algorithm? | IBM. (n.d.). https://www.ibm.com/topics/knn

[24] Tool
Google Vision AI
https://cloud.google.com/vision

[25] Tool
Quick, Draw!
https://github.com/googlecreativelab/quickdraw-dataset

[26] Tool
Hand pose detection
https://github.com/tensorflow/tfjs-models/tree/master/hand-pose-detection

[27] Tool
Palette extractor
https://github.com/googleartsculture/art-palette/tree/master/palette-extraction

Arrangement of artworks

- **PixPlot library [28]**
  It can be used to cluster visually similar images together in a two-dimensional projection.

- **Three.js [29]**
  This JavaScript library can be used to create and display animated 3D computer graphics in a web browser using WebGL [30].

Gamification

- **Metadata of the artworks**
  Descriptive data that provides information about the artwork. Examples of an artwork's metadata could be artist, production place, date of creation, and techniques used for it. Metadata could be used to build educational games.

- **Firebase [31]**
  A platform developed by Google for creating mobile and web applications. It can be used to store and sync the real-time data of users. It is useful for building a multi-player collaborative platform.

[28] Tool
PixPlot library
https://github.com/YaleDHLab/pix-plot

[29] Tool
Three.js
https://threejs.org/

[30] Tool
WebGL
https://developer.mozilla.org/en-US/docs/Web/API/WebGL_API

[31] Tool
Firebase
https://firebase.google.com/

1.6 Design approach

In this project the Double Diamond Design Approach [32] is used combined with the Research through Design approach [33]. The design process consists of four phases: discover, define, develop and deliver.

Discover

In this phase, the context and design challenges were first explored by literature studies. Through interviews with staffs of Rijksmuseum, I was able to understand the museum's vision and reasons behind their interface design. By conducting interviews with creators and observations on how they seek inspiration online, I got a better understanding of the inspirational process of creators.

Inspired by the Research through Design approach, I started with rapid prototyping in this phase. By doing so, I was able to experiment the possibilities of current technology.

Define

After analyzing all the data and information gathered in the discover phase, I was able to define the design goal and my target group. Besides, several useful insights were concluded which formed the initial inspiration for my design. A design brief is concluded with a design goal and an interaction vision at the end of this phase.

Develop

During this phase, several design ideas are generated through brainstorming. Four working prototypes were developed using Javascript. They were evaluated and compared with each other by seven participants. By using these prototypes as research artefacts I was able to gain new insights and revise my design direction. Besides, the interface of the chosen prototype was redesigned and its usability was tested with ten participants.

Deliver

In the final phase of the project, a high fidelity interactive prototype was created to demonstrate the final design. The final prototype was evaluated with ten artists. The goal of this user test is to validate to what extend does my concept make museum online collections inspiring for artists. Both qualitative and quantitative data were analyzed. Attrakdiff scale was used for assessing the attractiveness of the design. Interviews, thinking out loud and observations were used to gather qualitative insights.

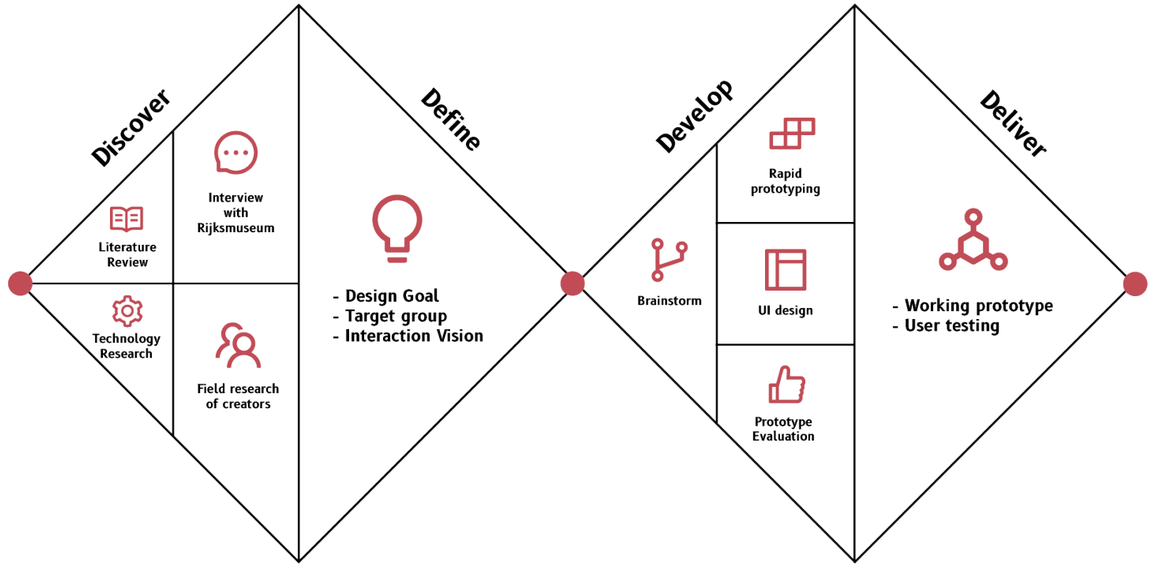


Figure 12. Overview of the design process

[32] Reference
Design council. (2019). *Framework for Innovation: Design Council's evolved Double Diamond.* www.designcouncil.org.uk. https://www.designcouncil.org.uk/our-work/skills-learning/tools-frameworks/framework-for-innovation-design-councils-evolved-double-diamond/

[33] Reference
Jan Stappers, P., & Giaccardi, E. (2015). *Research through Design.* The Interaction Design Foundation; UX courses. https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/research-through-design

2 Design Research

After briefing the project, it is time to understand the museums and their audiences in a real context. In this chapter, Rijksmuseum and creatives are invited for interviews. Afterwards, The needs of creatives are analyzed and discussed.

2.1 Interview with Rijksmuseum

In order to better understand the value of the museum and its target group, an interview with a senior member at the Rijksmuseum was conducted. The main questions targeted in this interview session were:

1. What is the target group of Rijksstudio?
2. To what extent does Rijksstudio achieve Rijksmuseum's goal?
3. How does Rijksmuseum use user-generated data, such as the number of likes of each artwork and user-generated collections and descriptions?
4. What is Rijksmuseum's future plan for its online collections?

The main insights are shortly described below.

Rijksmuseum's vision

Since Rijksmuseum is the national museum of the Netherlands, its vision is that the museum collections belong to everyone. The public should have free access to the collections, similar to Wikipedia. During the renovation in 2013, Rijksmuseum's collections are digitized.

Target group

Rijksmuseum defines the following target groups based on the sets their audience made in Rijksstudio:

- **Researchers**, who conduct researches on specific artworks
- **Art lovers**, who has a high appreciation for visual arts
- **Hobbyists**, who make collections of hands, eyes, or other details, which are visually beautiful
- **Culture snackers [34]**, who like to do fun things with images via smartphones
- **Creative people**, who use artworks as inspiration for their creative purpose. This user group is mainly targeted through Rijksstudio Award.

Rijksstudio

Rijksstudio is inspired by Pinterest's interface because of its simplicity and popularity. Rijksstudio allows users to make personal sets and share them. This function makes Rijksstudio famous, because it really opens up the collections.

Rijksmuseum's most famous collections are displayed on the home page of Rijksstuido, along with a chronological timeline of the sets that users made. In this way, the diversity of the collections comes to the surface. However, compared to Pinterest, users of Rijksstudio are less active and usually stay not long. Rijksstuido is available on both PC and mobile devices. The app is usually used as a multi-media tool during the visit. Rijksstudio is mostly used on PC because its web version has more functions.

Rijksmuseum is also familiar with various Google Art experiments. However, these cool features were not used on its website because of the Pareto principle: 80% of your visitors use only 20% of the available functionality. Rijksmuseum believes that the interface should be focused and simple in order to benefit the largest possible target group [35].

User-generated data

Rijksmuseum had social tagging functions in the beginning. Social tagging are user-defined tags on image collections. However, unlike crowd-sourcing websites such as Vele handen, Rijksmuseum does not have tagging managers to double-check the user-generated tags. As a result, it ended up with some trash tags created by malicious users. Rijksmuseum had to remove this function. Now online users can only give names to the sets they made. According to the interviewee, this is a more natural way of tagging.

Another way to collect data from the audience is through contact emails. Audience sometimes send emails to point out the incorrect information on display.

Currently, Rijksmuseum does not focus on user-generated data. Maybe it would be useful for Email-marketing by targeting the audience individually based on their interests.

Future plan

The future challenge will be delivering the meta-data in a more storytelling way rather than a list of results. For example, displaying a timeline of the life of a famous painter or a timeline that shows the events that happened at the same time. The *oorlogskranten.nl* was used as an example during the interview. The information on this website is generated with linked data. Linked data is structured data that can be read automatically by machines and freely used.

Another challenge will be integrate semantic data with user-generated data. For example, through searching for Rembrandt, users will get a semantic page with the artworks related to or influenced by Rembrandt. In this way, the art collections will be distributed better.

[34] Reference
Engberg, M. (2017). Digital Archives, the Museum and the Culture Snacker. *POLITICS PRACTICES POETICS*, 14. https://www.diva-portal.org/smash/get/diva2:1405349/FULLTEXT01.pdf#page=14

[35] Reference
Sanders, R. (1987). THE PARETO PRINCIPLE: ITS USE AND ABUSE. *Journal of Services Marketing*, *1*(2), 37–40. https://doi.org/10.1108/eb024706

2.2 User study

As mentioned in Chapter 1, creators' needs are not met with current museum websites. In this part, I will look deeper into this group of people.

Goal

In order to obtain a thorough understanding of creators' inspirational process, WWWWWH Method [36] were used to analyze the situation in a structured way. Before answering the main research question, the five W-questions should be answered first.

[36] Method
Delft Design Guide WWWWWH: WHO, WHAT, WHERE, WHEN, WHY, AND HOW

Main question:
How to support creators in seeking inspiration in online collections?

Sub questions:
- **Who** is involved in the inspirational process?
- **What** are the things creators looking for to get inspired?
- **Where** do creators find inspiration online?
- **When** do creators need inspiration from online collections the most?
- **Why** do they need inspirational stimuli?

Participants

6 creators were recruited by convenience sampling [37]. One of them is a designer, and five of them are artists from beginner to professional level [Figure 13].

[37] Method
Sedgwick, P. [2013]. Convenience sampling. *BMJ*, *347*[oct25 2], f6304–f6304. https://doi.org/10.1136/bmj.f6304

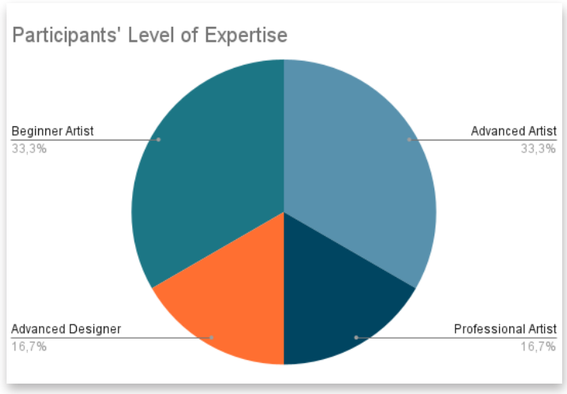


Figure 13. Participants' level of expertise

Procedure

The whole session includes the following parts:
1. Interview about the creative experience
2. Assignment of seeking inspiration online
3. Interview about the inspirational journey
4. Try out Rijksstudio
5. Interview about the experience with Rijksstudio

Methods

Interview
Before and after the assignment, participants were asked about their creative experiences and ways to find inspiration.

Observation
During the assignment, I noted down the steps that the user takes during their inspirational process.

Think out loud
Participants were asked to share every thought on their actions while using online collections to seek inspiration for their creative purpose.

Results

Who?
For most artists, the inspirational process is an individual process [Figure 14]. When seeking advice on specific technological issues, their colleagues could be involved. For designers, finding inspiration is a social activity. New ideas will emerge via peer discussion.

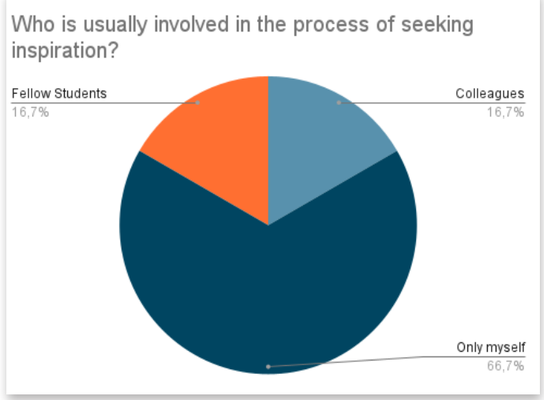


Figure 14. Involvement of people in the process of seeking inspiration

What?
Depending on what the creators create, the preferred type of inspirational stimuli varies. The three most common types of material that creators use as inspiration are photographs, sculptures, and drawings [Figure 15].

Creators consult photos for learning details of a specific object or creature. Sculptures are used for studying how messages are delivered and how different elements work together. Drawings are used by artists to study composition, specific styles, and drawing techniques.

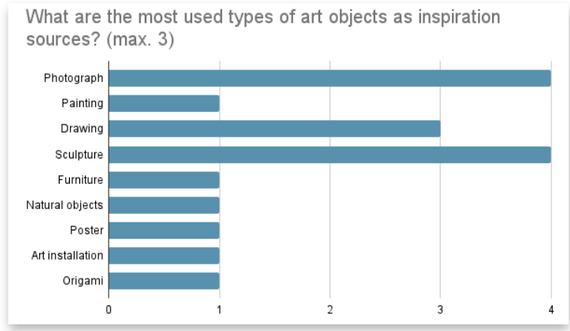


Figure 15. Mostly used types of art objects

Where?

Different websites and apps are mentioned during the interview. Below are the top three platforms that creators use for seeking inspiration.

Four out of six participants like Pinterest, because it contains a large image database from all over the world. It is easy to search on Pinterest because from its widely varied collections users can always get their search results. Besides, users can make boards with their favourite images. This allows them to collect and cluster their inspirational stimuli. Furthermore, the system constantly recommends images to users based on their interests. Some participants claimed that this improves the effectiveness of the seeking inspiration.

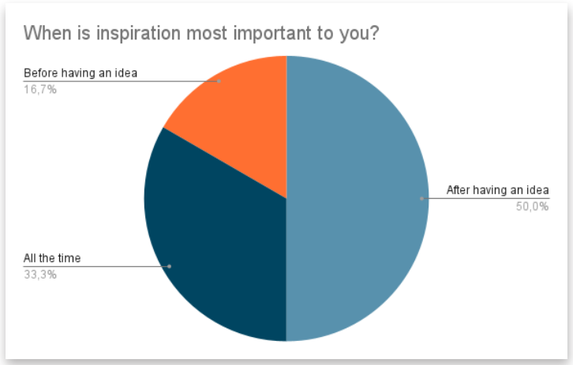


Figure 16. Answers of the participants on the question "when is inspiration most important to you?"

Google Images is experienced as simple and direct. It is usually used for specific searches because Google Images allows natural language search. This means that users can enter a sentence to describe the information they are looking for. Same as Pinterest, it has very large image database.

Participants like to browse curated pages for one theme or one artist on Instagram. They can follow artists and get notified when new works are posted. Besides, Instagram also has a smart recommendation mechanism that learns users' interests.

When?

For the designer and the professional artist, inspirational stimuli are important all the time. For the other four artists, inspirational stimuli are most important after having some ideas in mind (Figure 16).

Why?

Creators have different goals for seeking inspirational stimuli. Their goals are clustered into the following three categories.

1. Technique
Artists seek inspirational stimuli for studying new techniques, such as brush technique and application of new materials. They will use new knowledge to improve their skills.

2. Details
Inspirational stimuli are used for studying details, such as patterns, human poses, color usage, and combination of elements.

3. Abstract level
Artists need inspirational stimuli to feel a vibe to start with. Besides, they are interested in how emotion and messages are expressed in the artwork. According to the designer, stimuli without direct correlation help him generate new ideas.

How?

Designers are trained to use diverse methods, such as brainstorm, moodboard and analogies, to find inspiration for new solutions. Artists are freer with their inspirational process. An overview of the artists' inspirational process is summarised below (Figure 17).

The results of interviews showed that artists get inspired by their environments subconsciously. This finding is inline with the statement of the famous visual artist Cornelia Parker: '*like a microscopic jigsaw puzzle, tiny points of stimulus accumulated over time come together in an instant, making you think you have had an idea that came from nowhere*' [38]. After having some small thoughts in mind, they use online image collections for further exploration.

Artists first shape what they want to search by formulating some keywords as the search input. After getting the search results, they try to feel the vibe of the images. This is an iterative process. It begins with a general search term. While exploring, artists find out what they really want to see gradually. After that, they reformulate the search term and this cycle is restarted.

After the searching process, they study the artwork carefully. They want to learn how to create the same effect. Besides, they also reflect on their own works and see how they can combine the new knowledge with their current skills. This step leads to creative activities.

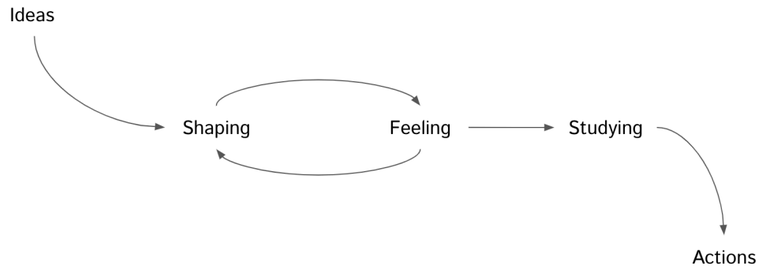


Figure 17. *Online* inspirational process of artists

[38] Reference
Aksnes, D., & Whittet, C. [2006]. Creativity-Opening Pathways To The Hidden Power Of Creative Practice. In DS 38: *Proceedings of E&DPE 2006, the 8th International Conference on Engineering and Product Design Education, Salzburg, Austria, 07.-08.09. 2006* [pp. 259-264]. https://www.designsociety.org/download-publication/28230/Creativity+-+Opening+Pathways+To+The+Hidden+Power+Of+Creative+Practice

Useful insights

During the observation, activities that the participants took were recorded. The notes can be found in Appendix B. These actions were clustered into the following four categories:

1. Set up a mood
Some artists tend to set the creative mood for improvising. This helps them find their creative direction. Usually, they get touched by the things happening in their surroundings.

2. Semantic associations
During the searching process, artists are constantly brainstorming by making word associations. For summer-related ideas, they may use 'outside', 'sea', 'children', etc. as search input to get the vibe of summer.

3. Visual associations
Making visual associations is another way to diverge ideas while searching and browsing. A jellyfish, for example, is associated with a mushroom due to the similarity in their shapes. Besides, artists like to browse visually similar images recommended by the system.

4. Start from own experience
Artists may take a look at their earlier works if they are lacking inspiration. There are some motifs that artists would like to use again. They also like to study the works of their favourite artists to get inspired.

5. Natural language search
Artists often change search terms to get the most accurate search results. They tend to use a natural language search if they do not know the exact term.

Rijksstudio impression

After seeking inspiration with their frequently used platforms, participants were asked to use Rijksstudio for the same creative purpose. After that, they were asked to reflect on their inspirational process on Rijksstudio. The pros and cons of Rijksstudio according to the participants are listed below.

\+ **High-quality of images**
Participants could enlarge the image to study the detail.

\+ **User sets are interesting to browse**

\- **The searching system is not smart enough**
Participants had the feeling that they need to have prior knowledge for using Rijksstudio. Finding the desired results would be difficult if they did not know the correct term. Furthermore, the search results are usually less relevant to the search term when searching in English. Participants felt demotivated or their thoughts may be interrupted if the page shows "no results".

\- **The collections are too old**
Designers and digital artists prefer modern artworks.

2.3 Conclusion

In this chapter, field studies were conducted. The insights of the user study are summarized below.

Novice Artists

There is a difference between artists and designers. Concluded from the interview results, designers prefer modern inspirational stimuli. As a result, museum art collections are less useful for them to use as inspirational stimuli. Besides, designers have various design methods to follow. Compared to artists, they have a more organized procedure for finding inspiration. On the other hand, artists are more open to inspirational stimuli. They work more flexibly and intuitively. They like to view museum collections to learn some art techniques from them. However, for professional artists, museum collections are less interesting to browse since they already learned a lot about art history. Therefore, I decided to focus primarily on novice artists as my target group.

Opportunities for Rijksstudio

Rijksmuseum targets creative people through Rijksstudio Award and its Pinterest-like interface. However, there are still possibilities for improvement:

- Lower the knowledge threshold for searching artworks
- Explore various ways to search
- Create connections between collections and other knowledge bases on the internet
- Use user-generated data for creating a personal experience

These insights serve as a starting point for generating ides in the ***Develop*** phase.

3 Design Brief

Based on the knowledge gained from the design research, the target group and design goal are defined in this chapter.

3.1 Target group

At the beginning, the target group is decided on the inspiration-motivated audience which include both artists and designers. However, after the user study, it was interesting to notice that artists and designers have different needs and different methods for finding inspiration. In general, museum collections are more valuable for beginner artists. The target group of my design is therefore narrowed down to beginner artists.

Based on the interview findings, inspiration is the most important for artists after having initial ideas. To be more specific, **the target group of my design is beginner artists who have initial ideas to start with**.
Other characteristics of the target group are shown below (Figure 18).

Want to be original
Artists combine the new knowledge with their current skills rather than copying other art styles

Values
Learning, exploring

Personality
Curious, open, intuitive, creative

Figure 18. *Characteristics of the target group*

3.2 Design Goal & Interaction Vision

Based on the findings of prior research, I formulated a design goal and an interaction vision [39] as the criteria for my design.

[39] Reference
Pasman, G., Boess, S., & Desmet, P. (2011). Interaction vision: expressing and identifying the qualities of user-product interactions. In DS 69: Proceedings of E&PDE 2011, the 13th International *Conference on Engineering and Product Design Education, London, UK, 08.-09.09. 2011* (pp. 149-154). https://www.designsociety.org/publication/30876/Interaction+Vision%3A+Expressing+and+Identifying+the+Qualities+of+User-Product+Interactions

My design goal is to help novice artists seek inspiration in museum online collections.

Figure 19. *Interaction Vision*

Interacting with my design should feel like coloring in a coloring book.

In this case, it should be a **focused**, **creative** and **individual** experience.
The corresponding interaction qualities are:

Guiding

The outline drawings in the coloring book are used as guidance for coloring.

My design should guide the user through the process of seeking inspiration in museum online collections.

Resonating

The coloring book creates a shared creative experience between the user and the artist.

My design should evoke personal meaning or specific emotion while exploring the museum online collections. It makes users get closer to the feeling they are looking for, so that they can gradually build up their imaginary scenes.

Encouraging

The coloring book helps users relieve stress and get energized again. It also release the creativity as users will lose themselves in the flow of coloring.

My concept should encourage users to take action after exploring the online collections.

4 Design Cycle 1: Divergence

After the literature and field study, four design ideas are formed and prototyped in this chapter. They are tested with seven participants. The results of the user tests are analyzed and discussed at the end of this chapter.

4.1 First insight

Through the user study, several methods that are used by artists for seeking inspiration were concluded as following:

1. Set up a mood
2. Text associations
3. Visual associations
4. Start from own experience
5. Natural language search

The primary goal of this design cycle is to evaluate **to what extent these methods help novice artists get inspired.** Since the last method, natural language search, is more about designing a new AI system which falls outside the design scope, I decided to only focus on the first four methods. After evaluating these methods with quick prototypes, I can choose to focus on one method or combine multiple methods together in my final concept.

4.2 Brainstorm

[40] Method
Delft Design Guide
How-Tos

With these insights in mind, I brainstormed with five designers at TU Delft's Industrial Design Engineering faculty. The How-To questions [40] are formulated upon the three interaction qualities in a less specific way which allows freer thoughts. All the generated ideas can be found in Appendix C.

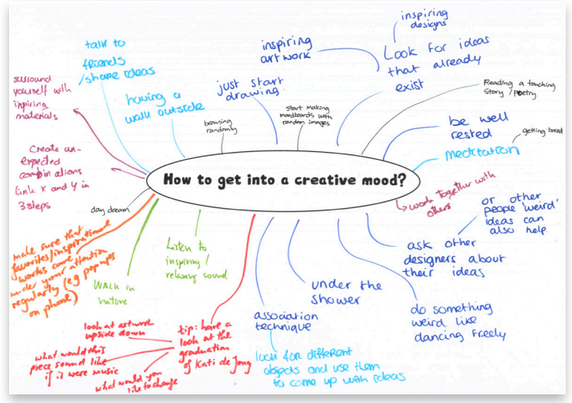


Figure 20. *Example of the brainstorm results*

How-Tos

Guiding

- How to assist users to find their interests during browsing online collections?
- How to help people express what they would like to browse?

Resonating

- How to create the museum atmosphere online?
- How to present artworks online in an engaging way?

Encouraging

- How to help online visitors study a specific artwork in detail in an interactive way?
- How to get into a creative mood?

4.3 Quick prototypes

After combining the first insights and interesting brainstorming ideas, I formed four ideas and developed a quick JavaScript prototype for each of them using Visual Studio. These ideas are realized by using open-sourced datasets and machine learning libraries. An overview of the used tools and data was shown below (Figure 21). Each prototype has specific limitations due to the imperfection of the tools.

First Insights	Prototype	User Input	Tools for analysing users' input	Type of data used	Source of database
1. Set up a mood	**MoodBoard**	An Emoji	-	Artworks with **emotion annotations generated by human**	Artemis + Wiki Commons
2. Text association	**MindMap**	A keyword	**DataMuse API** Word association generator	Artworks with **user-generated tags of objects or themes**	JSON file with User-generated sets on Rijksstudio
3. Visual association	**Sketch to Search**	Doodle sketch	**Quick, Draw!** for detecting doodle drawings	Artworks with **titles and descriptions**	WikiArt API
4. Start from own experience	**Style Analyzer**	A piece of art	Image classifier	Artworks with **style labels**	WikiArt API

Figure 21. *Overview of used tools and dataset for four prototypes*

MoodBoard

The first prototype Moodboard draws upon the first method that artists use before creating: getting in a specific mood. In general, artworks are created to express some emotions and messages. This prototype is designed to help users generate their personal moodboard based on their desired emotion.

Link to the prototype: https://shunqit.github.io/moodboard/index.html

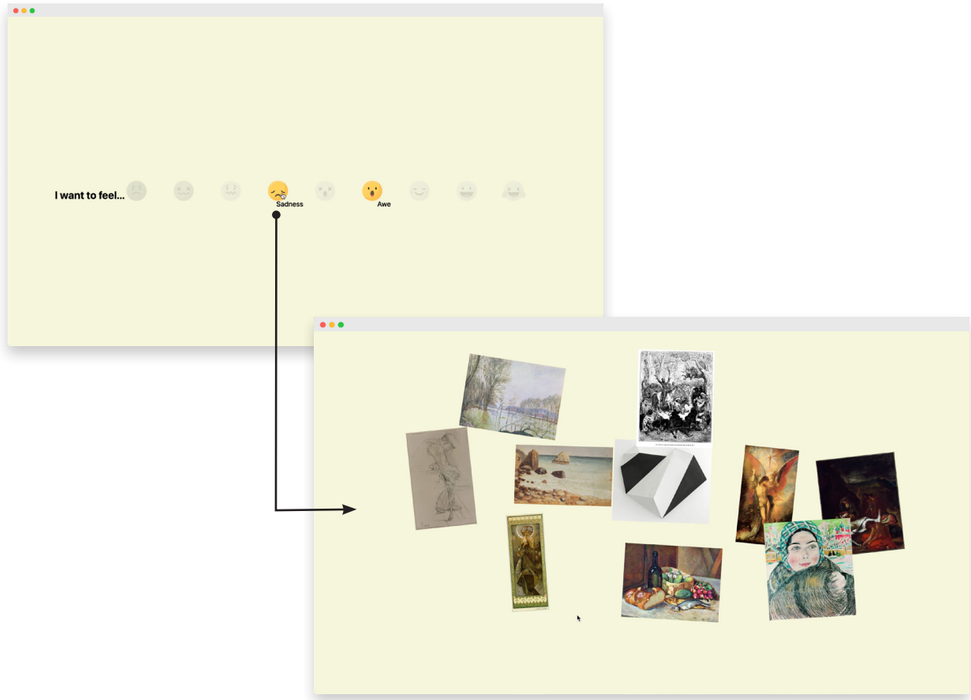


Figure 22. *Screenshot of the prototype MoodBoard*

After picking up an emotion on the home page, the system collects artworks that are annotated with the chosen emotion. These artworks are displayed one by one by clicking on the canvas. By doing so, users can carefully review the artwork rather than glancing it. This prototype enables users to create their own moodboard to get into the mood that they have chosen. Hopefully, they could learn how masters convey emotion in their works. Inspired from real moodboards (Figure 23), the images are displayed slightly tilted.

Figure 23. *Examples of real moodboards*

AI & Tool

This interactive online moodboard tool is built using JavaScript and the Artemis dataset.

Artworks evoke different feelings from humans. One study conducted by Stanford University tries to understand the link between artworks and their emotional effect. Their output is the Artemis database, which has 455K emotion annotations and explanations from humans on 80K artworks from WikiArt [41]. These emotion data are clustered into eight categories: ***Amusement***, ***Awe***, ***Contentment***, ***Excitement***, ***Disgust***, ***Fear***, ***Sadness***, and ***Something else*** (Figure 24). Users can select one of these eight emotions as the starting point of their exploration. All the artworks in the Artemis dataset that are labelled with the chosen emotion will be located and displayed.

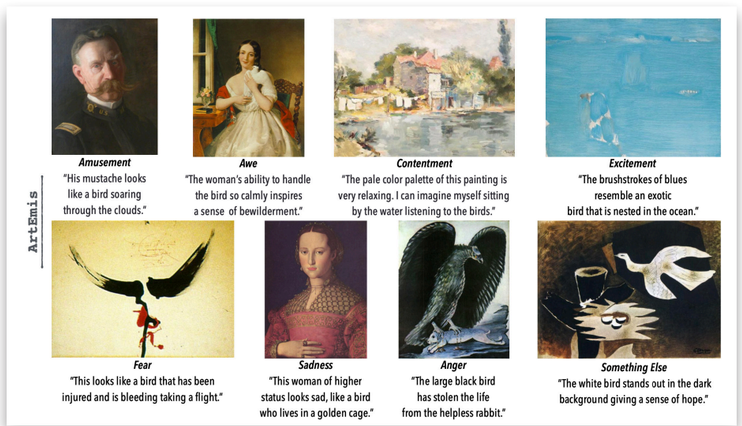


Figure 24. *Example of the Artemis emotion annotations*

[41] Reference
Achlioptas, P., Ovsjanikov, M., Haydarov, K., Elhoseiny, M., & Guibas, L. J. (2021). ArtEmis: Affective Language for Visual Art. Openaccess. thecvf.com. https://openaccess.thecvf.com/content/CVPR2021/html/Achlioptas_ArtEmis_Affective_Language_for_Visual_Art_CVPR_2021_paper.html

User Input

At the beginning, I thought that it is more natural to read emotion from users' facial expressions directly. To do this, I applied an open-sourced emotion detection tool, Face API [42], to my prototype (Figure 25). However, the Face API's output is not as accurate as expected. Two participants were recruited for a quick test session with emotion detection using Face API. Participants felt uncomfortable to act out the emotion they would like to get in front of the webcam. Especially when the system detected it wrong, they felt disappointed and loose interest to act out the facial expression again. In addition, using this AI library caused a lot of lags which negatively affect the user experience and test results. As a result, I decided to switch to a simpler way of user input.

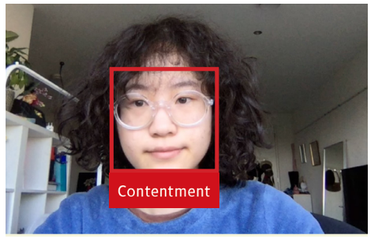


Figure 25. *Screenshot of the Face API*

Emoji is a universal way to express emotion [43]. Representative emojis are selected for the eight emotions that Artemis has clustered. This way of user input was tested again with peer students. It was experienced as more clear and direct.

Limitations

Due to different interpretations of artworks, the output of this prototype could not fully match users' expectations. One painting could evoke a variety of feelings. At first glance, some people were attracted by the use of colour, while others focused more on the content of the work. Thus, the perceived mood differed a lot. Moreover, as the study of Artemis only investigates the impact of paintings, only paintings are displayed in this prototype.

[42] Tool
Face API
https://github.com/justadudewhohacks/face-api.js/

[43] Reference
Giannoulis, E., & Wilde, L. R. (2019). Emoticons, kaomoji, and emoji: The transformation of communication in the digital age. In *Emoticons, Kaomoji, and Emoji* (pp. 1-22). Routledge. https://www.taylorfrancis.com/chapters/edit/10.4324/9780429491757-1/emoticons-kaomoji-emoji-elena-giannoulis-lukas-wilde

Link to the prototype: https://shunqit.github.io/mindmap/index.html

MindMap

MindMap is inspired by the list of trends that social media suggests to users on the homepage. For those who do not have a concrete search plan in mind, these search trends might be helpful. The user-generated datasets from Rijksstudio were used to calculate the top 20 most popular themes of artworks. These themes are displayed on the homepage, inviting users to explore. Of course, users can also manually enter a keyword.

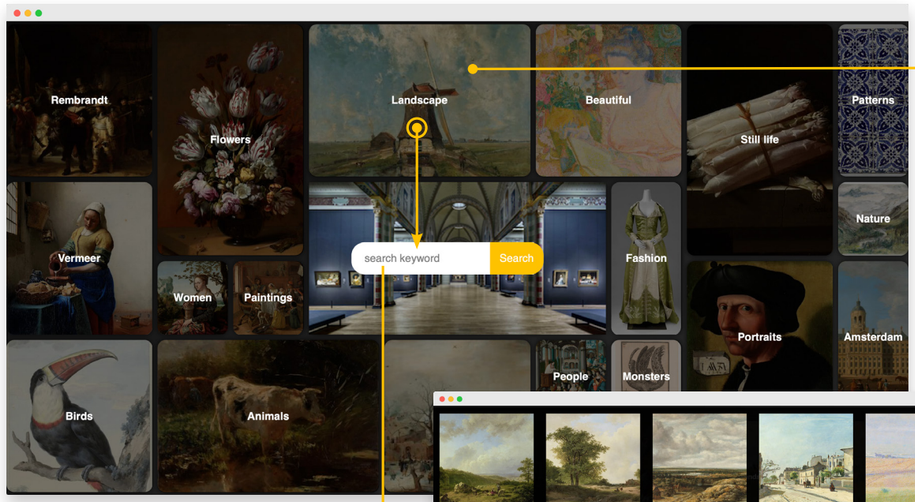
[44] Tool https://data.rijksmuseum.nl

Pinterest and Instagram are popular among artists because of their smart recommendation algorithms. I want to make this recommendation process transparent in a way that the system is not analyzing users' behavior but brainstorming together with users. Combined with the finding that artists make word associations when searching, I came up with the idea of generating a mindmap of the search term [Figure26]. The system generates related themes based on the search input. These themes should be surprising for the user and lead them to unexpected results. In my prototype, the relevance of the theme to the search term is indicated by the size of its image on the screen.

For each category, representative images are collected from user-generated sets and retrieved from Rijksstudio's API [44]. Step by step, the system helps users find out what they actually like.

Figure 26. *Initial idea of this prototype*

The top 20 popular themes in Rijksstudio are shown on the home page



Click to see more images of this category

Type in a keyword manually or drag a category to the search box for generating related themes

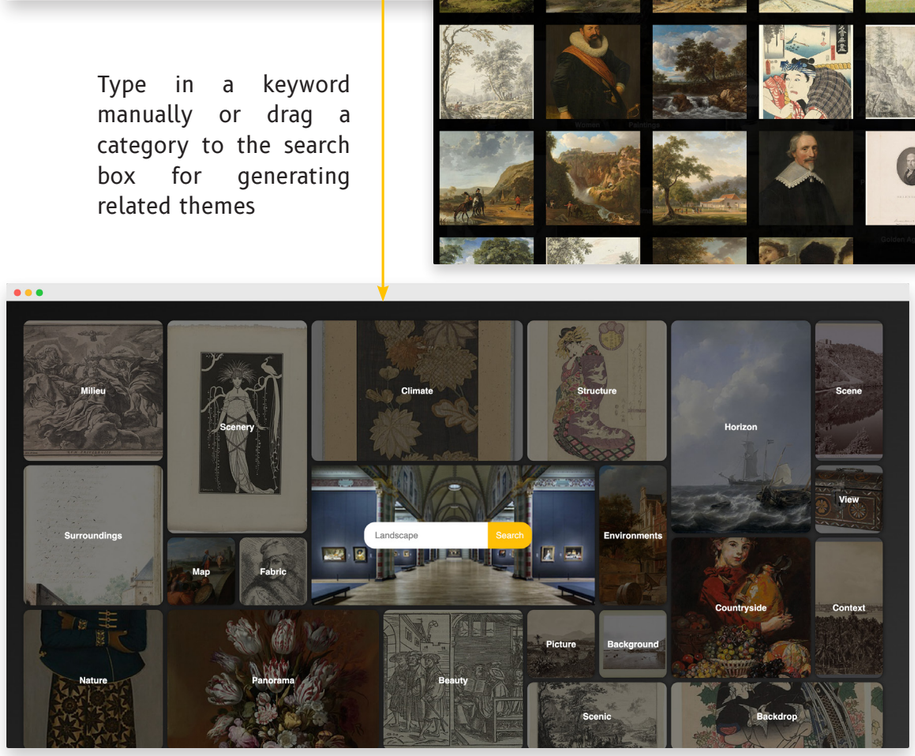


Figure 27. *Screenshots of the prototype MindMap*

AI & Tool

Datamuse API [45] is used to generate related words based on the search word. For example, if the word “animals” is used as the input, the AI-suggested related words are “creature,” “beast,” “fauna,” etc. [Figure 28].

[45] Tool
Datamuse API
https://www.datamuse.com/api/

Figure 28. *Screenshot of Datamuse API*

While exploring different museum APIs, I discovered that Rijksstudio has unique user-generated content APIs. These APIs give researchers access to sets of objects created by users in Rijksstudio. However, these APIs are built with Elastic Search which has a limitation on the number of requests. Thus, a JSON file with the information of 163,862 user-sets is requested from Rijksmuseum/Q42. Additional filters are implemented while exporting an overview of the public user-sets:

- Only user-created sets are included; automatically generated sets were ignored.
- Only the IDs of the set and the object numbers of the artworks are included in the file
- Due to privacy reasons, private sets created by the user were skipped.
- To ensure that the user-sets were appropriate for prototyping, sets with less than 3 items were skipped.

Figure 29. *Screenshot of JSON file of user-generated sets*

In this prototype, names of the user-sets are used as user-generated tags for artworks. Users’ search keyword is used to locate all the artworks in Rijksstudio that are associated with the search query.

Limitations

The system does not support multiple word searches, since it is difficult to match the search phrase with user-generated tags precisely. This might result in less or no results.

Artworks may be grouped into the wrong category by other users, because user-generated sets are not reviewed by art professionals. Thus, some displayed images could be random for the user.

Sketch to search

Link to the prototype:
https://shunqit.github.io/draw/index.html

The idea behind Sketch to Search is to validate a finding from the literature study that using sketches as search input might help creators more effectively express what they are looking for. Combined with one of the early findings from the user study–creators usually make visual associations when searching–I developed this prototype to match users’ doodle drawings with artworks.

Users are encouraged to sketch out the shape or idea they have in mind. The algorithm analyses the drawing and provides ideas for what the drawing might look like based on similarities in shape. Artworks that are labelled with these objects will be displayed.

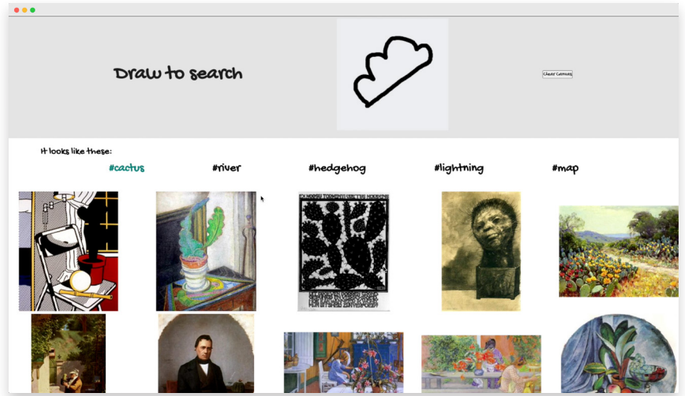


Figure 30. *Screenshot of the prototype Sketch to Search*

AI & Tool

Quick, Draw! dataset is used for making predictions of users’ doodle drawings. By using the Quick Draw API, my prototype can detect 345 categories.

WikiArt API [46] is used in this prototype because it has more painting collections than Rijksstudio has.

Limitations

Since my prototype is used on the laptop, users’ performance is constrained by the mouse and/or touchpad. Besides, the doodle recognition AI can only detect one object at once. Its predictions are not always correct.

Retrieving data from WIkiArt API causes some CORS [Cross-Origin Resource Sharing] problems. For security reasons, the browser sends requests differently when my prototype page and API have different domains. When the server detects such a request, it usually blocks it by default. In order to get this prototype working, users need to activate the *Allow CORS Plugin* on Google Chrome [47].

[46] Tool
Wikiart API
https://www.wikiart.org/en/App/GetApi

[47] Tool
CORS Plugin
https://chrome.google.com/webstore/detail/allow-cors-access-control/lhobafahddgcelffkeicbaginigeejlf

Link to the prototype: https://shunqit.github.io/style/index.html

Style Analyser

Style Analyser was developed to help artists review artworks. Users' early works or works of their favourite artists can be used as the input in this prototype. By displaying the AI-detected art style and other masterpieces that fit this style, users get a better understanding of their currently liked styles. According to the user study, the suggested materials by Pinterest could keep users stuck in the style they earlier liked. To prevent this filter bubble, one solution that is generated during the brainstorming session is showing works with contrasting styles. This function has been included in this prototype to better help users analyze different artworks.

After uploading a piece of work that the user would like to study, the system shows two predicted categories of artworks: similar and contrast styles.

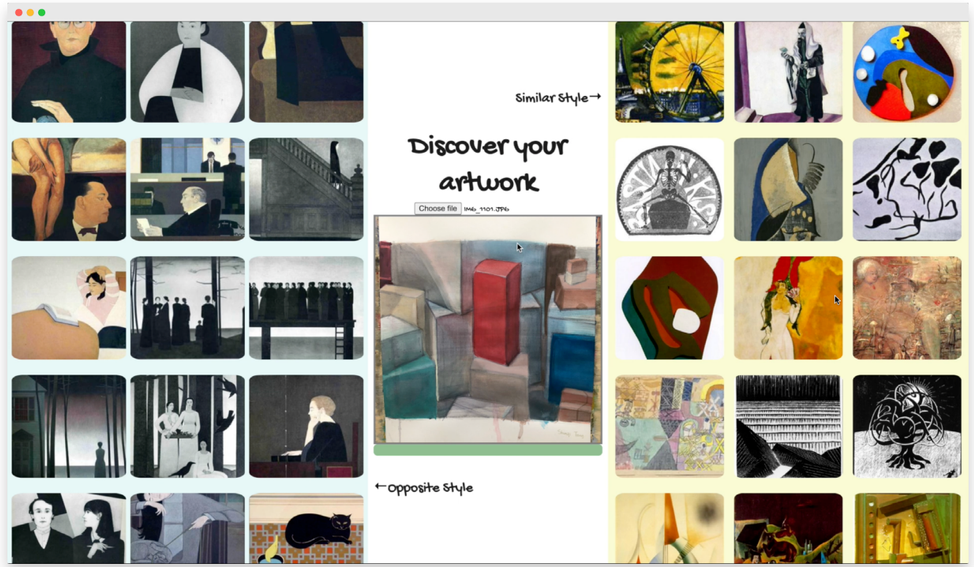


Figure 31. *Screenshot of the prototype Style Analyser*

AI & Tool

In this prototype, an image classifier for recognizing artists and art styles is used [48]. This open-sourced machine learning model contains a Convolutional Neural Network-based Keras model which is trained to detect eight selected artistic styles: ***cubism***, ***expressionism***, ***fauvism***, ***graffiti art***, ***impressionism***, ***pop art***, ***post_impressionism***, and ***surrealism***.

Machine learning algorithms can make mistakes when predicting a value based on input data. Confidence scores demonstrate the probability that the algorithm successfully identified the image [49]. In my prototype, the detected style which has the highest confidence score is regarded as the similar style, while the one with the lowest score is seen as the opposite style. As shown in Figure 32, surrealism has the highest confidence score of 1.00, while popart has the lowest confidence score. In this case, the most similar style of my painting is surrealism according to the algorithm.

The images are retrieved from WikiArt API by making a style search query.

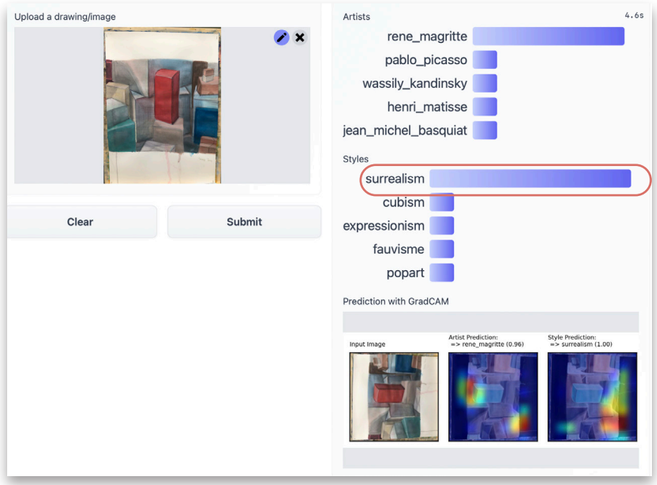


Figure 32. *Screenshot of the results of the image classifier*

Limitations

The training sample size for each art style is too small and the model can only detect eight art styles. For each style, only 100 representative paintings were trained. It is suggested to train a CNN model using a dataset that is bigger than 5,000 samples [50]. As a result, the accuracy of this image classifier is low, which may not entirely match users' expectations. Moreover, due to the use of the WikiArt API, CORS problems occur with this prototype.

[48] Tool
Image classifier for artistic styles
https://huggingface.co/spaces/jkang/demo-artist-classifier

[49] Reference
Confidence Score - an overview | ScienceDirect Topics. [n.d.]. www.sciencedirect.com. Retrieved September 19, 2022, from https://www.sciencedirect.com/topics/computer-science/confidence-score

[50] Reference
Moghadas, Davood. [2020]. Re: How to determine the adequate number of data sets required for convolutional neural network?. https://www.researchgate.net/post/How_to_determine_the_adequate_number_of_data_sets_required_for_convolutional_neural_network

4.4 Prototype Evaluation

The primary goal of the user test was to explore whether the prototypes achieved the desired interaction qualities. The four prototypes were tested one by one with the same participants. This was done to enable the comparison of the experiences with the four prototypes, which would help in evaluating the desirability of the ideas.

Participants

Participants (n=7, 1 male, 6 female) were recruited through convenience sampling. All participants have a design or art background. Participants were asked to imagine they are novice artists who would like to create a piece of art while testing with prototypes.

Methods

After the try-outs, participants were asked to score three statements from one to seven, while one stands for 'Strongly Disagree' and seven for 'Strongly Agree'. The three statements represent the three interaction qualities, as shown below. Participants were also asked to explain their scores and discuss the advantages and disadvantages of each prototype. To wrap up the test session, participants were invited to grade these four prototypes from most to least inspiring.

Guiding
The prototype leads the user through the inspirational process.

Resonating
The prototype makes the user get closer to the feeling he/she is looking for.

Encouraging
The prototype motivates the user to take action.

Data Collection

The analysis of the interview results was structured around the three interaction qualities.

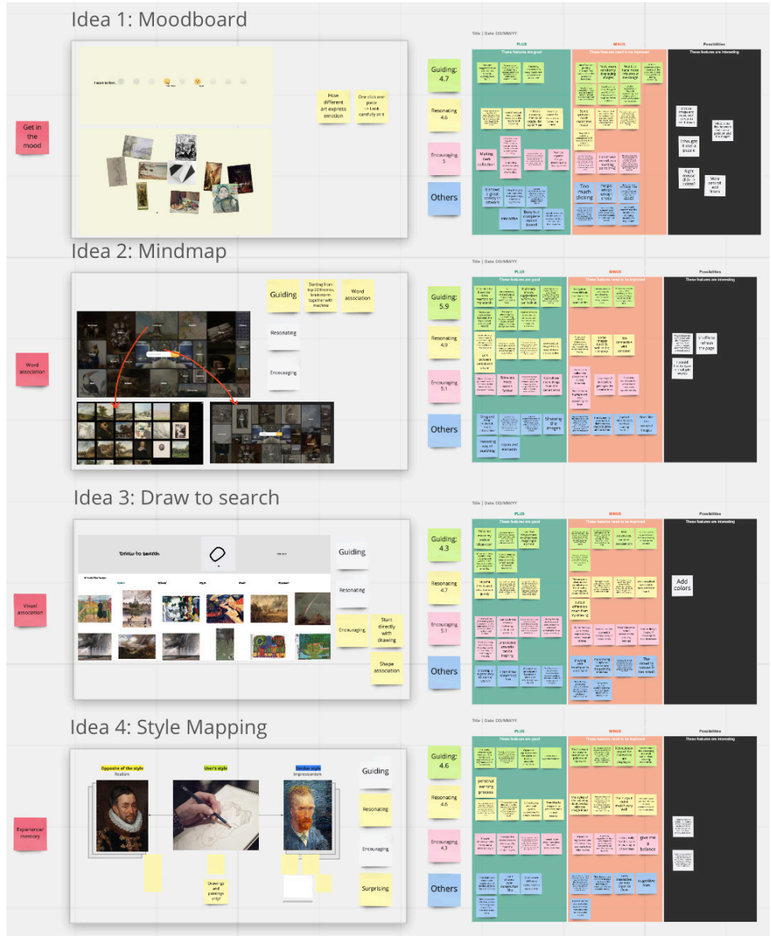
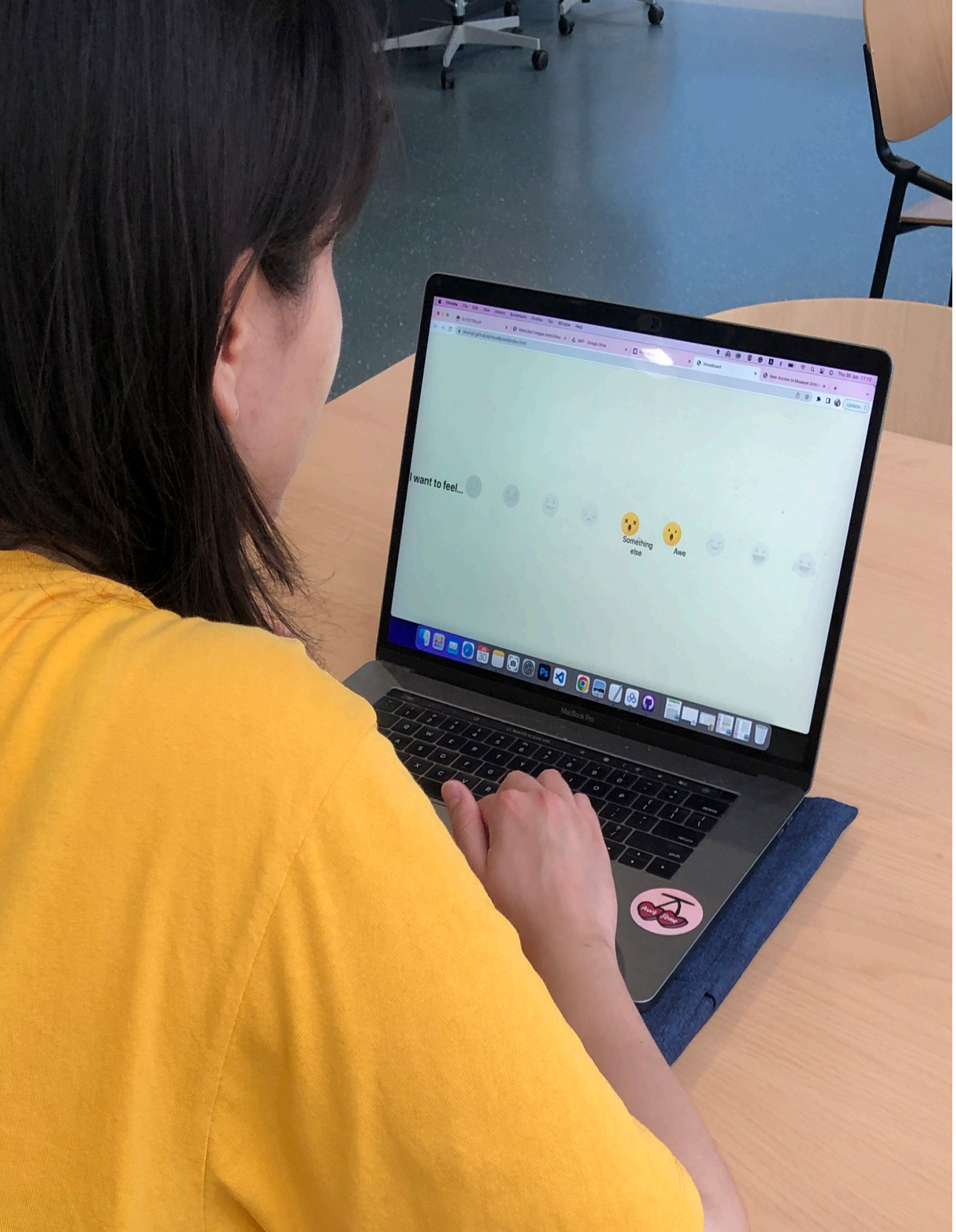


Figure 33. *Screenshot of PMI tables on Miro board*

The qualitative data for each prototype were clustered into a Plus-Minus-Interesting table [52], which can be found in the Appendix D. The key findings for each prototype are presented in the following pages.

Diagrams were used to illustrate the quantitative information, which included the ranking of these four prototypes and the score for each interaction quality.

[52] Method
Delft Design Guide
PMI table



Moodboard

Guiding (4.7/7)

Interaction with this prototype was experienced as **easy** and **surprising**.

Some participants like the surprisingness of the artwork. It was **guiding** for them because the system was making the decision/selection for them.

Some participants experienced this **randomness** as less guiding due to the **lack of control** over the output images.

> choosing an emotion was very easy. It leads me to see more and more images.
> -P1

> You get suggestions so you do not have to actively look for it.
> -P2

> I would like to have less of this and more of that.
> -P7

Resonating (4.6/7)

Due to **different interpretations** of the artwork, not all pieces match participants' chosen emotion. However, they could still be **inspiring** for users.

> These images differ a lot in style. They give me mixed feelings.
> -P2

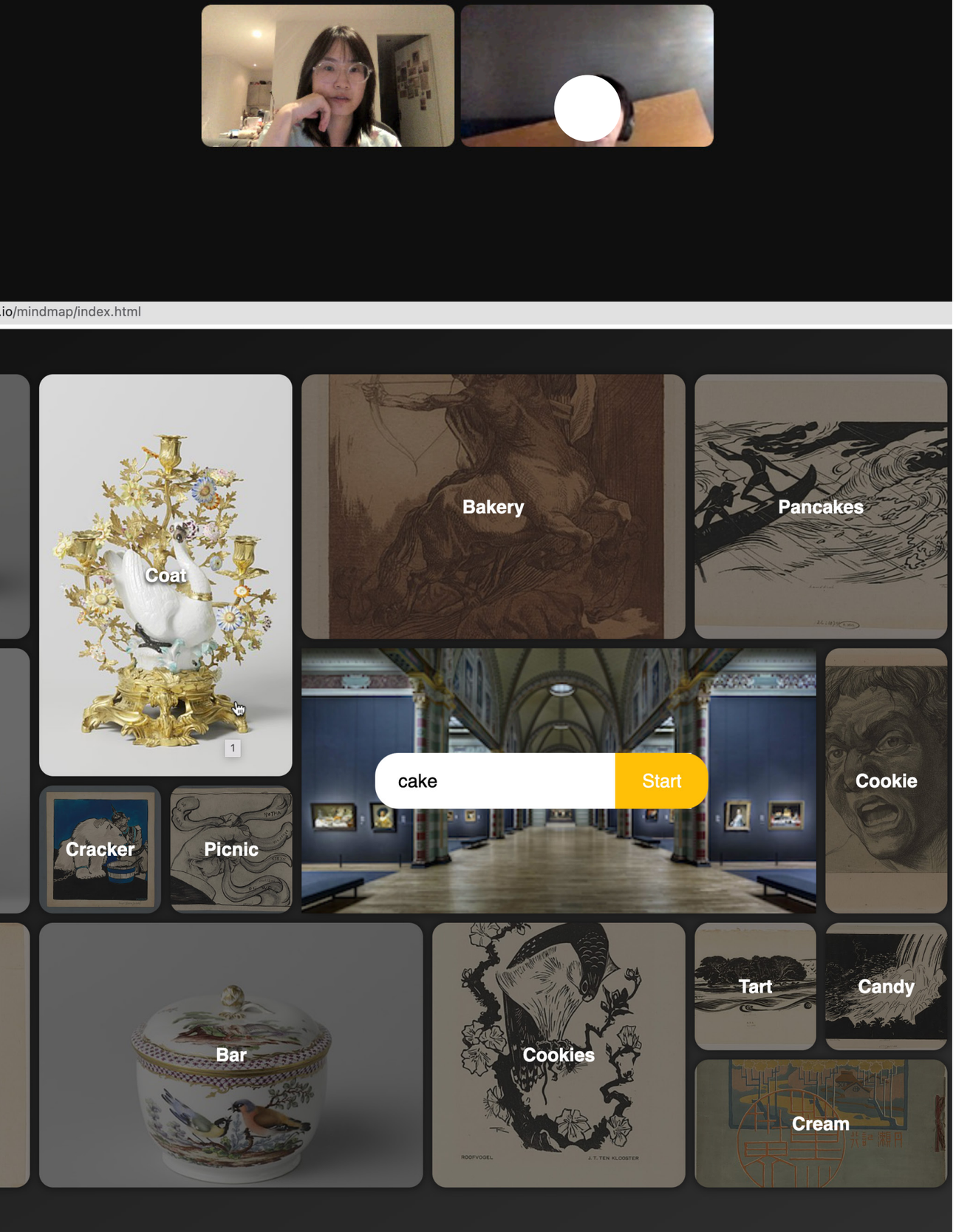
> Some pieces fit my emotion. They really spark me and I'm willing to study them more.
> -P1

Encouraging (5/7)

Surprising images **encouraged** users to click and explore the art collections more and more.
In addition, it helped users make their personal moodboard which enables them to seek connections between selected pieces. Users would like to **organize** images after having a complete moodboard.

> It's similar to the algorithms of TikTok, I can not stop clicking. The images are random but also surprising.
> -P5

> You cannot sort the artworks (moving them) like putting artworks in similar styles next to each other since you might like some artworks but do not think they fit together.
> -P2



MindMap

Guiding (5/7)

Firstly, participants found that the links between their input and the output results with MindMap were more distinct than with MoodBoard. Based on the keyword input, participants are **guided** in their exploration by a number of suggestions of related subjects.

However, participants would like to have control over the search depending on their preferences. Some people preferred to narrow their searches inside the term, while others preferred to receive more unexpected results that helped them come up with new ideas. Showing all the suggestions might cause **information overload**.

> When typing in a keyword you also get related keywords to search for themes you had not thought of before so it is quite leading. -P2

> My search habits are compatible with this approach. Typically, I create a mind map while I work on a design. -P2

> There are too much information and opportunities. -P7

Resonating (4.9/7)

This prototype forms a bridge between textual and visual information. Participants were able to get a **feeing for the theme** they wanted to explore by looking at the artworks that corresponded to the related words. Some images, however, did not fit well in the category.

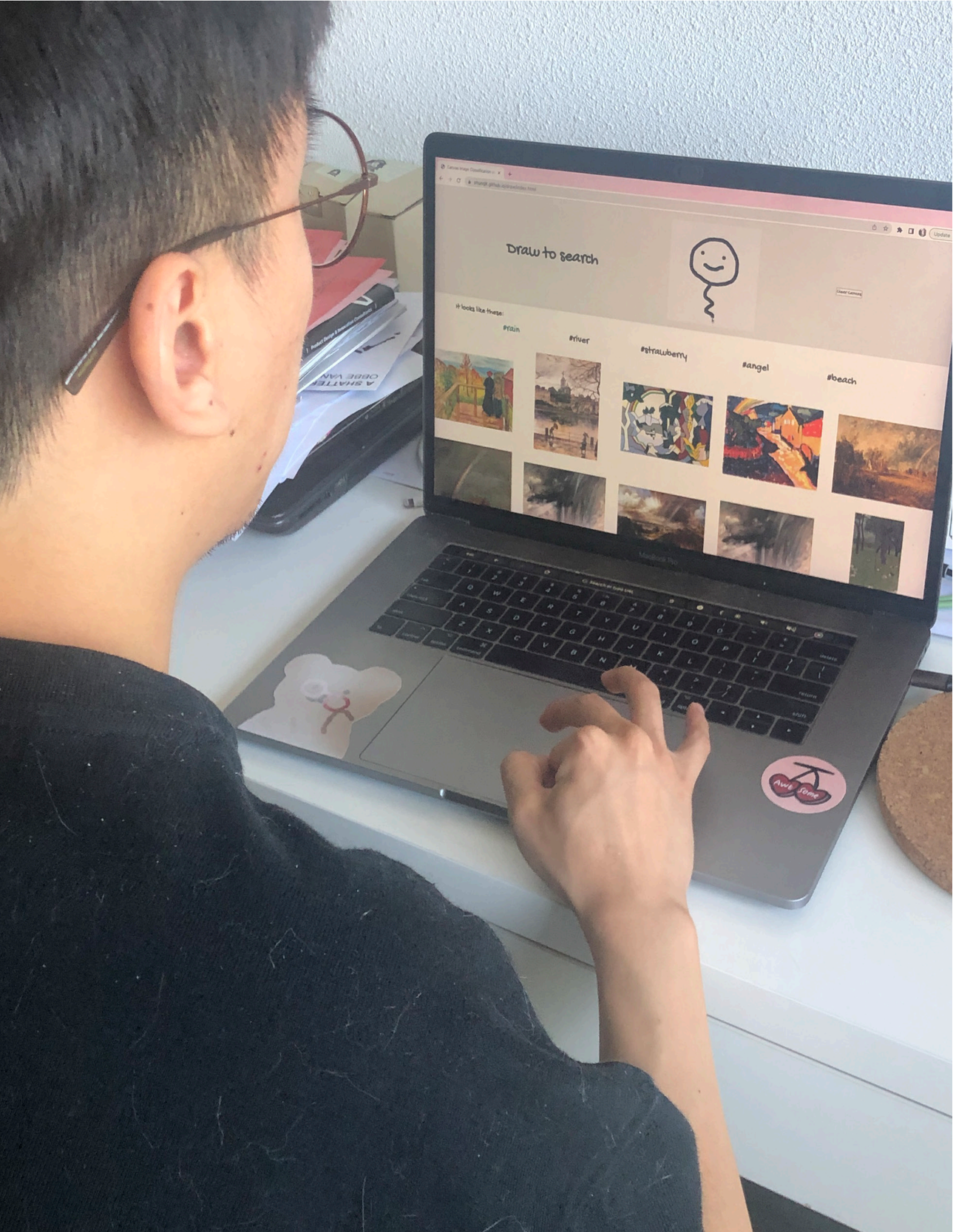
> The artworks fit more together, in terms of colour and style, with some deviation as some artworks do not fit the keywords, but overall there is some sort of mood created. -P2

Encouraging (5.1/7)

This searching mechanism **stimulated** participants to go deeper into the collections. However, users might lose their purpose while using. To better assist users in exploring the collections, **additional features** are required.

> It does encourage me to explore different topics that show up, even though they are not what I originally want to search. -P1

> I hope I can collect the pieces I want during browsing. -P5



Sketch to Search

Guiding (4.3/7)

Regarding using sketches as real-time search input, participants had varying opinions. This prototype helped those who have fuzzy ideas in their heads to **clarify** them. For those who have specific search goals in mind, this way of searching is **not optimal**. They had the feeling that they need to draw in a way that the system can understand. This reduced the level of control they have.

> When your idea is difficult to describe with words, it can help you match your ideas with artworks. -P4

> It seems more like a game because the system is guessing what you are drawing. If I want more accurate results, it does not help. -P6

Resonating (4.7/7)

Sketch to Search was experienced as **unpredictable** due to the AI's inability to accurately identify what users were drawing. As a result, the displayed artworks often **deviated** too much from what the participants had expected.

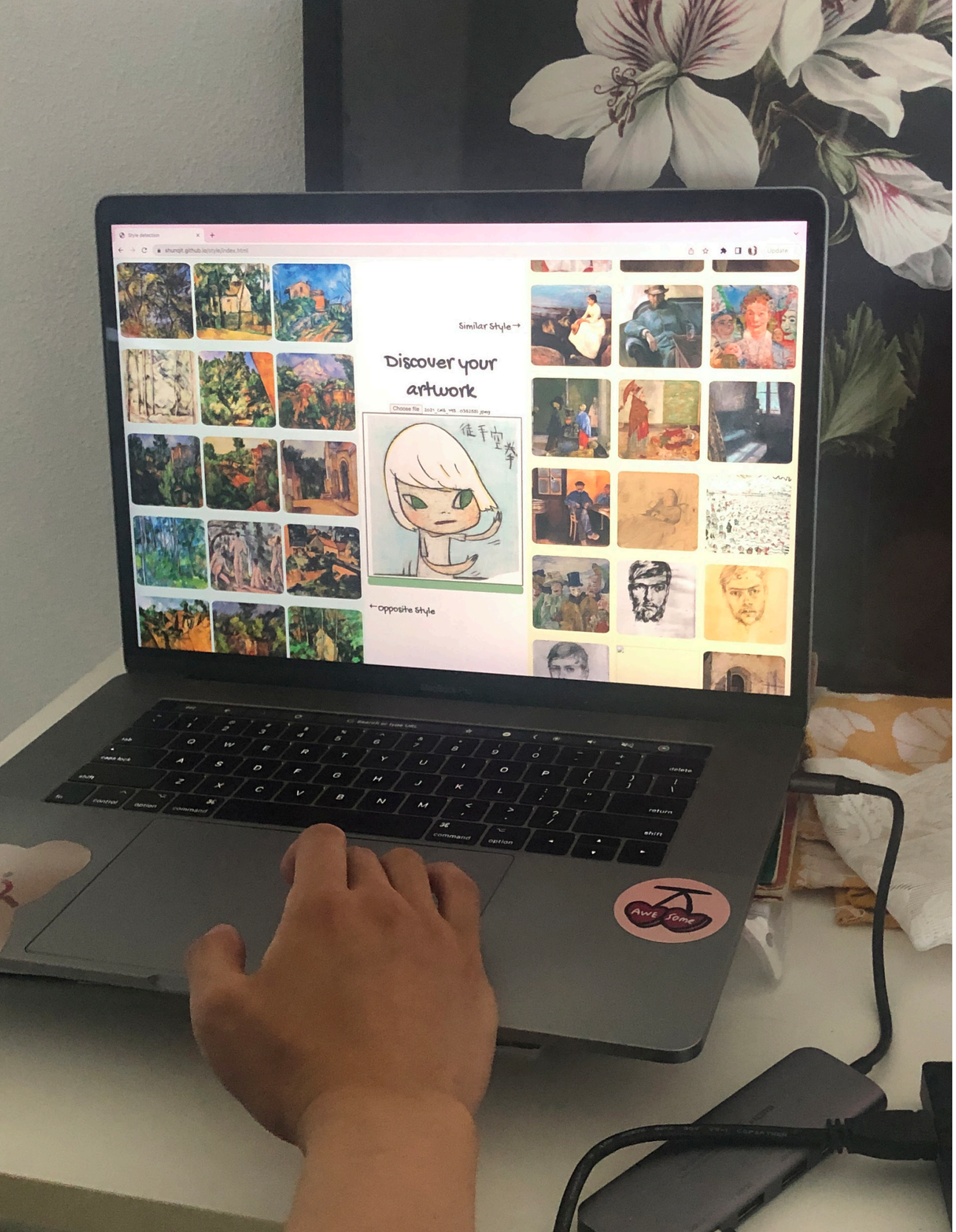
> Some of the pieces are surprisingly out of my expectation but they hit me well. -P5

> The artworks often do not correlate with the drawing making you relate less to it. -P2

Encouraging (5.1/7)

Taking the first step can be tough, but this prototype **encouraged** participants to doodle out their ideas. In general, participants had more fun with it than they did with the other three prototypes since searching through sketching is more interactive.

> Maybe because you are already creating something, by creating more drawings to find inspiration might also inspire you to make an actual artwork. -P2



Style Analyser

Guiding (4.6/7)

Participants were **guided in diverse directions** by similar and contradictory art styles. Participants who are unfamiliar with artistic movements or styles would **appreciate further information** on them.

> "The similar styles are what I would like to see. Just like Pinterest, it leads me to the works I might like. During this process, I keep asking myself what I really like and narrowing down the direction. -P6

> "I don't know any of the styles that are displayed. -P3

Resonating (4.3/7)

Using one's own artwork as a search input has been experienced as **personal**. For each participant, it was a unique learning experience. Due to the imperfection of the style detection machine learning, some participants **struggled** to relate to the suggested artworks.

> "Uploading my work and getting suggestions for it feels personal. -P2

> "I only want to see the styles I might like. The opposite style is meaningless to me. -P2

Encouraging (5.1/7)

Since some participants did not feel comfortable being compared to other pieces of art, the Style Analyser was perceived as **least encouraging**. There are also participants who found it more interesting to study artworks with styles that contrast from their own than works with similar styles. Most participants thought it was useful to see both opposite and similar styles at the same time. They would like to **learn** more about a particular artistic movement.

> "It seems more like assessing my work rather than seeking inspiration. -P5

> "It encourages me to take a step back and compare my work with the output results. I have a nice review on what kind of style I prefer more and what else I should give a try. -P2

Quantitative Data

To get an overall understanding of participants' experience, the average score for each interaction quality was calculated and mapped on a diagram with an average score of four [Figure 34]. Aside from that, participants were also asked to rank these four prototypes based on how useful they were for finding inspiration. The most useful one scored four points, while the least scored one point. The total score of each prototype was summed up and shown in the Figure 35. MindMap has overall the highest score.

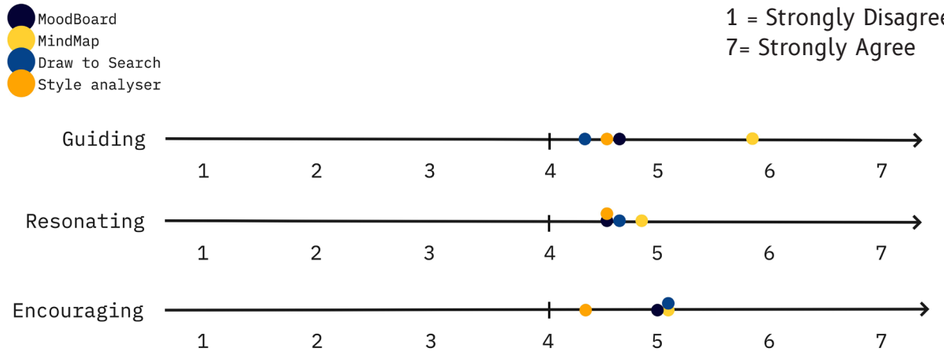


Figure 34. *Scores of each prototype on the three interaction qualities*

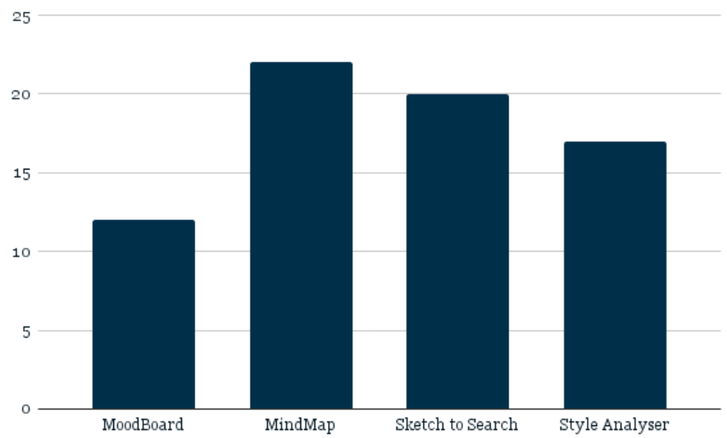


Figure 35. *Ranking of the four prototypes from most to least inspiring*

4.5 Conclusion

Through quick prototype testing, I am able to decide the direction of my final concept. Prototype MindMap has been experienced as the most inspiring, guiding, resonating and encouraging. However, there is still room for improvement. In the next Design Cycle, the following aspects should be taken into account:

Surprising ≠ Random

Prototype **Sketch to Search** was ranked second in inspiring with a very close score, because participants liked the surprisingness it gives. Thus, in my final concept, there should be an option to provide users with more surprising outcomes.

Although people appreciate variety, they do not accept completely random images that have no connection to the search query. Careful consideration should be given to the level of relatedness of the image results. This is something to be tested and improved in the recommendation algorithms in the future.

Converging ideas

While testing the fourth prototype **Style Analyzer**, participants mentioned that browsing works with similar styles helped them narrow down the direction they are looking for. In order to help users converge while finding inspiration, my final concept should include the feature of recommending similar works to users. To simulate this function, the user-generated sets of Rijksstudio could be used as a foundation for the recommendation system.

End of the exploration

MindMap invites users to browse more and more, yet it lacks a clear outcome. The exploration journey with my concept is intended to leave users with something. I discovered during user testing that users like collecting and studying their favourite pieces of art. Adding the function of collecting artworks and creating personal collections could fulfil their needs.

Avoid cropped artwork

In my prototypes, square-cropped images are frequently used, because they fit the layout better. However, participants prefer to see artworks in the full ratio since important parts of the artworks could be cropped. Displaying the images with the same width and proportional height as Pinterest does, is one way to solve this problem.

Feeling of control

Participants experienced **MindMap** as the most supportive because its way of searching is more direct and fits their search habits more. This is also the only prototype in which users can search through keywords. On the other hand, the search results offer too many opportunities that cause information overload while using.

5 Design Cycle 2: Convergence

In this chapter, a final concept is formed by combining advantages of three prototypes. Besides, the interface of the Mindmap is redesigned in a way that information overload is avoided.

5.1 Conceptualization

As a result of my findings from the literature and from the quick prototype tests, I defined the direction of my final concept as follows:

An online tool that allows users to make textual associations to diverge their ideas while also recommending them similar artworks to converge ideas.

The chosen concept MindMap focuses mainly on making textual associations. As discussed at the end of the previous chapter, the advantages of other prototypes could be integrated into my final concept. The two new functions of my final concept are presented below.

Similar works

People make clusters of images with similar visual characteristics on Pinterest [53]. These human-curated clusters form the foundation of the recommendation system. One popular way that people find inspiration on Pinterest is through Related Pins, an image-to-image recommender system that uses human-generated content to provide personalized recommendations of images [54]. The correlation between two images are calculated by how often they occurred in the same collection. The first version of Related Pins system shows frequently co-occurring images directly to users as recommendations. Later a machine learning model is applied to calculate weighted scores of each co-occuring images and rank them to maximize the relevance of similar works.

Since training a machine learning model of museum online collections is out of my design scope, I decided to simulate the function of suggesting similar works by using a simplified recommender system. Concluded from the Related Pins system, images that are saved together have a similarity that the user may find interesting. Therefore, user-generated data in Rijksstudio could be used to retrieve similar images that are saved together with the query-image, although the relevance of the similar images from Rijksstudio's user-sets is not as high as it on Pinterest.

[53] Reference
Han, J., Choi, D., Chun, B. G., Kwon, T., Kim, H. C., & Choi, Y. (2014). Collecting, organizing, and sharing pins in pinterest: interest-driven or social-driven?. *ACM SIGMETRICS Performance Evaluation Review, 42*(1), 15-27. https://doi.org/10.1145/2637364.2591996

[54] Reference
Liu, D., Rogers, S., Shiau, R., Kislyuk, D., Ma, K., Zhong, Z., Liu, J., & Jing, Y. (2017). *The Evolution of a Real-World Recommender System*. https://doi.org/10.1145/3041021.3054202

More surprising outcomes

Participants liked the surprisingness Sketch for Search gave. Besides, one study suggested that control over the level of abstraction of the search results should be provided in order to support seeking inspiration [15]. In order to simulate this function in my final concept, confidence scores of the related tags that are generated by the AI will be used to define the surprisingness of the tags. The lower the confidence score of the AI-generated tag, the more surprising and unpredictable the outcome of this tag could be to the user.

5.2 Interface ideas

Participants' feedback showed that there was an overload of information while using the prototype MindMap. The term "*information overload*" in digital interfaces is used to describe the situation where users are hindered by the excess of information during their decision-making process [55]. There should be a visual focus while distracting items are reduced. Concluded from the user tests, the causes of the information overload in MindMap's interface are as follows.

Firstly, the number of words presented on the homepage should be reduced. Every time a new search term is entered, the whole page is changing with the new images and texts. There is no guidance on where the participants should begin with. There are too many opportunities.

Secondly, the hierarchy of the output data is unclear. There are 20 images and words in different sizes. The larger the section the more recommended the tags are. However, due to the flexible placement of these sections, users cannot directly understand this principle. Some participants only looked at large sections and ignored the small sections which might be a pity. On the other hand, some participants only like to view similar content. Distantly-related themes are less interesting for them. It is not necessary to show them all on the home page.

Thirdly, participants focus on the images more than on the text. Now only one image is displayed for each tag. Some images do not represent the word well which confused the user.

After analyzing the factors that caused the information overload. Two recommendations for the final interface were formulated. A number of interface designs were created for these two ideas in order to explain them clearly.

[55] Reference
Tim. (2021, February 2). Managing Information Overload in UX Design: Miller's Law. Medium. https://medium.cobeisfresh.com/managing-information-overload-in-ux-design-millers-law-707a01348f54

1. Hierarchy in data

By splitting the closely-related and distantly-related tags in the interface, the hierarchy of the search results page becomes clear.

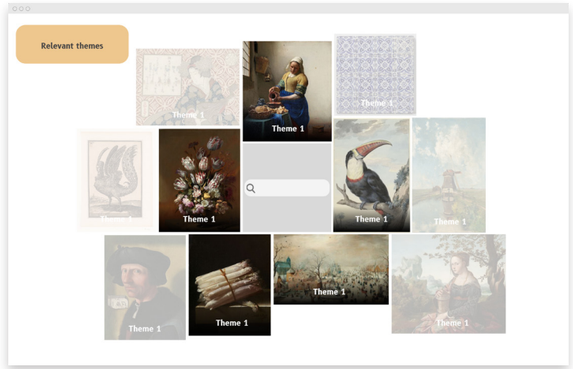


Figure 36. *Interface Idea 1 Hierarchy*

2. Search Options

By adding the filter options or a slider for adjustment, users can hide the category that they are not interested in.

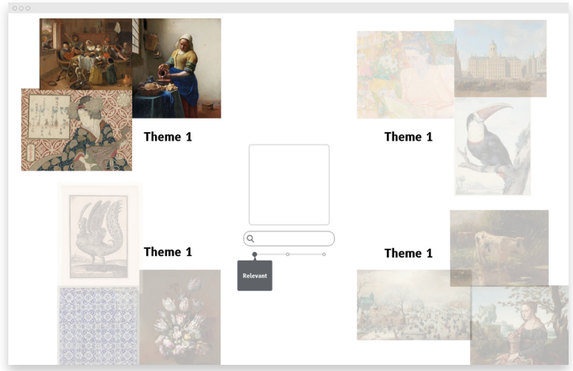


Figure 37. *Interface Idea 2 Search slider*

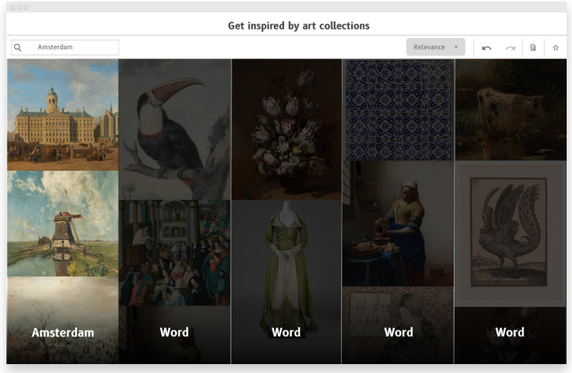


Figure 38. *Interface Idea 3 Search filter*

5.3 Selection

Four IDE students were invited to evaluate the interface ideas together. After the peer review session, I clustered the feedback for each idea into a PMI table. The completed notes can be found in Appendix E. The key insights are discussed below.

Filter options

Applying filter options is the most logical way because it allows users to filter out less interesting categories. The interface in columns appeared to be the cleanest and the most organized since each category is displayed with the same size.

Possible functions

During the discussion it has been suggested to add a **shuffle function** for each category. Since the vertically arranged interface looks like a slot machine, shuffling can be used as a metaphor for replacing the uninterested category with another related category.

Figure 39. *Slot machine as a metaphor for the interface design*

5.4 Scenario

There are mainly three phases in the user flow:

1. Browsing associated artworks on the homepage based on the search input
2. Studying a specific artwork
3. Viewing personal collections

Detailed actions in each scenario is concluded in Miro notes, which can be found in Appendix F.

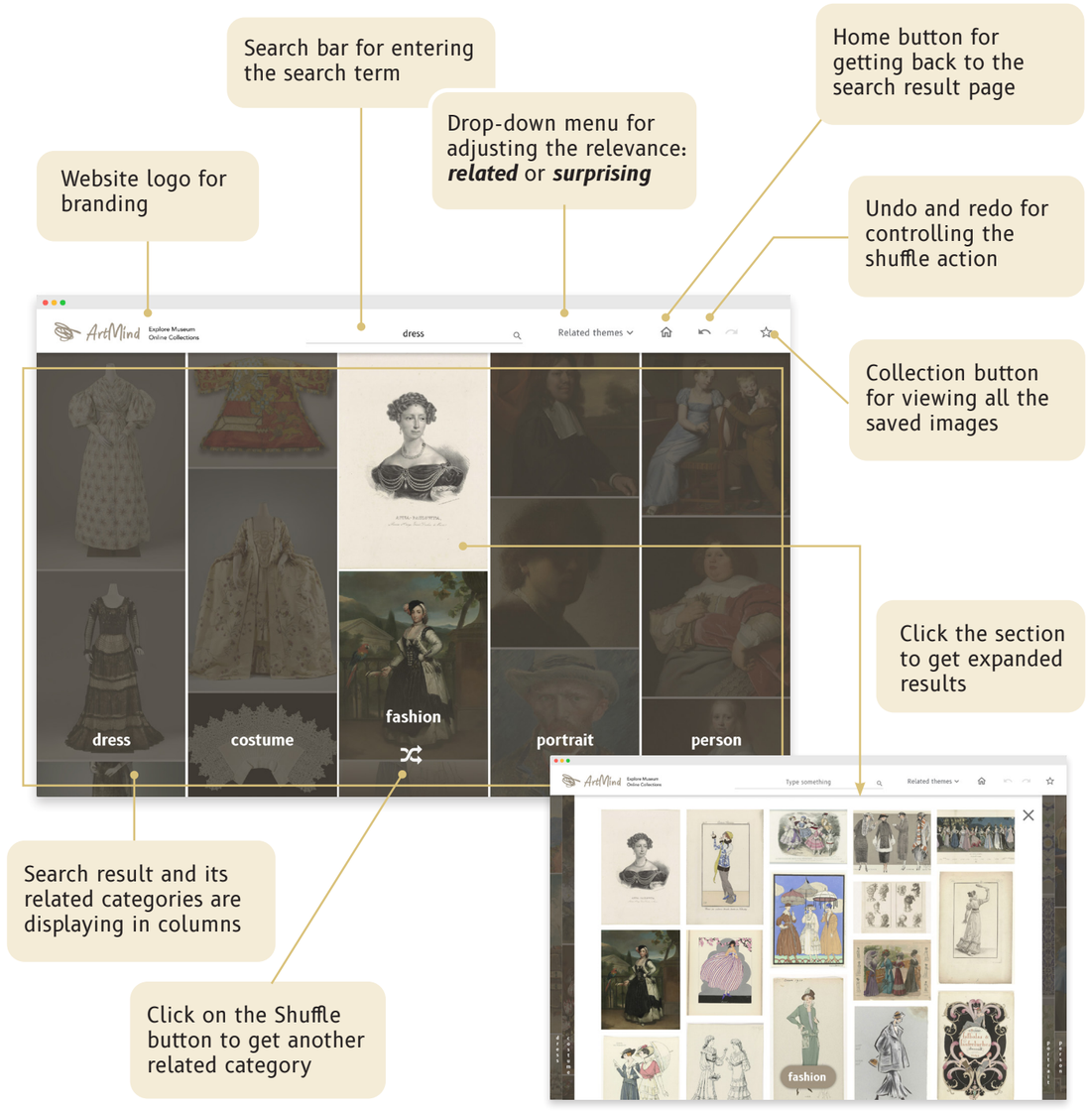
Figure 40. *Use Scenario*

5.5 New Interface

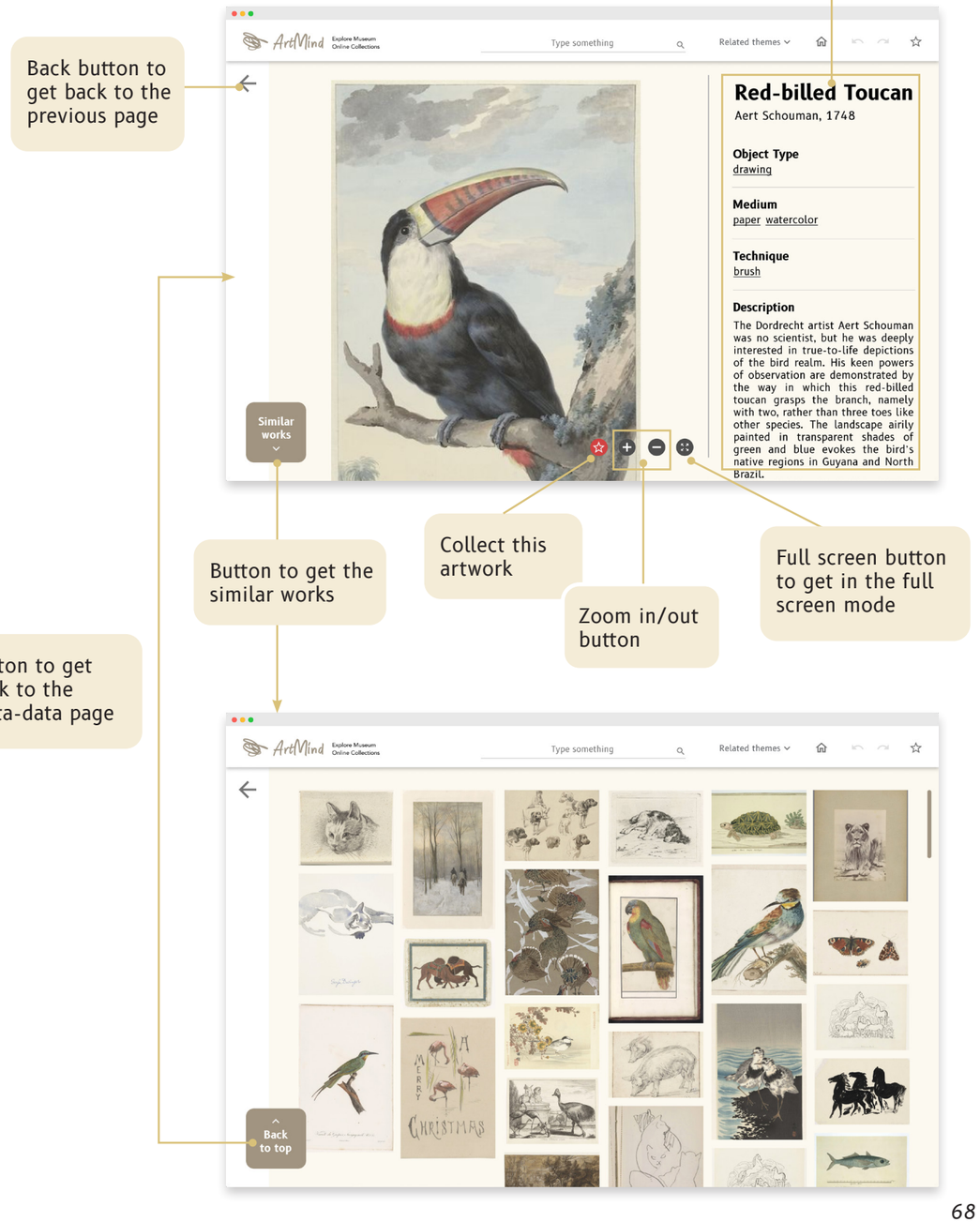
Link to the prototype:
https://bit.ly/3SePiUJ

Taking all the needed functions in mind, a Figma Prototype is created.
The main features of my concept are presented in this section.

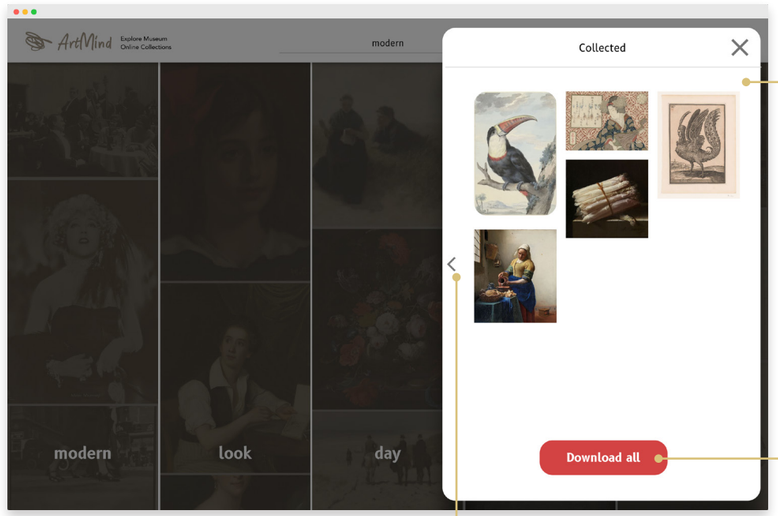
Home page



Information page



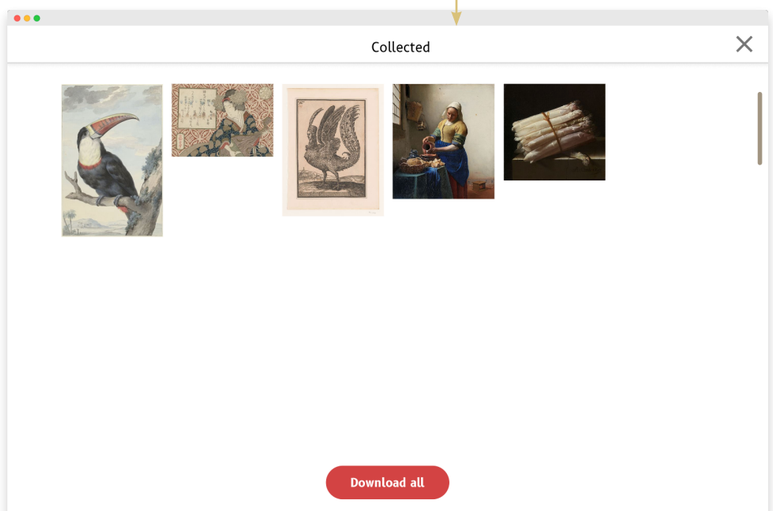
Collection pop-up window



Preview of the saved artworks

Download button for downloading all the favourite artworks

Maximize the pop-up window of personal collections



5.6 Usability test

The goal of the usability test was to find out whether the participants can understand all the functions of the prototype. The following research questions should be answered through this usability test:

1. **How do participants experience navigating through the website in general?**
2. **What other functions do they expect?**
3. **Is the feedback provided to the participants understandable and useful?**
4. **Are all the buttons in the interfaces understandable?**
5. **How does the style of the website fit museum online collections?**

Participants

10 participants were recruited through convenience sampling. They were seven experienced users and three new to the image collection websites.

Procedure

A pilot test was carried out to ensure that the process runs smoothly. The test consisted of three phases with a few sub-tasks, exploring with search results, studying artwork, and studying personal collection (Figure 41). Participants were guided with a session script. [56].

Part 1 Exploring search results

1.1 Study the search results page after typing in a keyword
1.2 Get less related search output
1.3 Shuffle one section
1.4 Undo the shuffle

Part 2 Studying an artwork in detail

2.1 Studying an artwork on the homepage in full-screen mode
2.2 Studying the technique of the artwork
2.3 Study similar works of the artwork
2.4 Collect artworks
2.5 Go back to the home page

Part 3 Studying personal collection

3.1 View collected artworks

Figure 41. *Tasks of the user test*

[56] Appendix
G. Instruction for the usability test

Methods for data collection

During the user tests, a number of techniques were used to collect data. Thinking out loud, interviews and observations were used to collect qualitative data. SUS and VisWAI-S questionnaires were used to collect qualitative data.

[57] Reference
usability.gov. [2019]. System Usability Scale (SUS) | Usability.gov. Usability.gov. https://www.usability.gov/how-to-and-tools/methods/system-usability-scale.html

Thinking out loud

Participants were asked to share their thoughts while experiencing with my prototype.

Observing

During observation, the number of wrong attempts was noted down for each task.

Interview

During the interview session after all the tasks, participants were asked with the questions mentioned in the beginning of this section.

SUS

SUS, or System Usability Scale, is a reliable tool for evaluating a system's usability [57]. Participants were asked to score 10 statements with one of five responses, ranging from 'Strongly Agree' to 'Strongly disagree' [Figure 42]. SUS helps designers effectively differentiate between use-friendly and unusable systems.

	The System Usability Scale Standard Version		Strongly disagree 1	2	3	4	Strongly agree 5
1	I think that I would like to use this system.		○	○	○	○	○
2	I found the system unnecessarily complex.		○	○	○	○	○
3	I thought the system was easy to use.		○	○	○	○	○
4	I think that I would need the support of a technical person to be able to use this system.		○	○	○	○	○
5	I found the various functions in the system were well integrated.		○	○	○	○	○
6	I thought there was too much inconsistency in this system.		○	○	○	○	○
7	I would imagine that most people would learn to use this system very quickly.		○	○	○	○	○
8	I found the system very cumbersome to use.		○	○	○	○	○
9	I felt very confident using the system.		○	○	○	○	○
10	I needed to learn a lot of things before I could get going with this system.		○	○	○	○	○

Figure 42. *System Usability Scale*

VisWAI-S

Visual aesthetics have a significant impact on the usability of the website [58]. The perceived visual aesthetics of my prototype was measured by using VisWAI-S [59].

VisWAI-S, known as a shortened version of Visual Aesthetics of Website Inventory. Through rating four statements with one of seven options, ranging from 'Strongly Agree' to 'Strongly disagree', participants evaluate the four crucial aspects of the aesthetics: Simplicity, Diversity, Colourfulness and Craftsmanship.

Simplicity reflects how well the Gestalt principles, such as unity, homogeneity, and balance are integrated into the design. Diversity investigates the variety and novelty of the interface. Colourfulness evaluates the selection and combination of colours. Craftsmanship assesses how professional the design is.

[58] Reference
Tractinsky, N., Katz, A. S., & Ikar, D. [2000]. What is beautiful is usable. *Interacting with computers, 13*[2], 127-145. https://doi.org/10.1016/S0953-5438[00]00031-X

[59] Reference
Moshagen, M., & Thielsch, M. [2013]. A short version of the visual aesthetics of websites inventory. *Behaviour & Information Technology, 32*[12], 1305-1311.https://doi.org/10.1080/0144929X.2012.694910

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
1. Everything goes together on this site.	①	②	③	④	⑤	⑥	⑦
2. The layout is pleasantly varied.	①	②	③	④	⑤	⑥	⑦
3. The color composition is attractive.	①	②	③	④	⑤	⑥	⑦
4. The layout appears professionally designed.	①	②	③	④	⑤	⑥	⑦

Figure 43. *Shortened version of Visual Aesthetics of Website Inventory*

Results

Qualitative data

Notes during the interview and observation were organized and analysed. The full version of the notes could be found in Appendix H. Insights were summarized to address the five research questions listed at the start of this section.

Navigating

Navigation within ArtMind was experienced as **easy** by most participants (7 out of 10). Users liked the minimal amount of options which makes the system not complex.

They also appreciated the **coherence** of the interface, because there are not many page jumps.

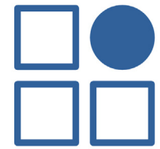
Three participants found the system **confusing**. One reason for this is that the supporting functions, such as undo and redo are in the same hierarchy as the special functions such as the filter.

Functions

Participants expected functions such as making groups for collections and getting recommendations for related artists. Besides, participants want to scroll down on the home page to see more images directly.

Feedback

In general, the provided feedback was **valuable**. However, participants needed more **visual distinctions** between the sections for the main search results and the related themes. In addition, **more animations** are needed to show the interface transitions.



Buttons

The ***SHUFFLE*** icon is not clear for four participants. According to them, this icon could mean sharing, randomly picking, or replacing all the images in the section.

Besides, the ***UNDO*** button is also confusing. Since it is far away from the shuffle button, participants were not sure that that this button is used for undoing the shuffle action.

Three participants failed to find the button ***SIMILAR WORKS*** due to its placement and colour.

Furthermore, the ***HOME*** button is not recognizable in the header. Participants tended to click on the logo to get back to the homepage.

The **drop-down filter** did not work as expected. Four participants failed to find the surprising option during the user test. This filter button, as the core function of my design, did not stand out. In addition, participants did not understand what these filter options mean.

Style

The style of my design was experienced as **elegant** and **simple**. According to participants, displaying the artworks in columns is a **novel** way that makes the website look like a leaflet.

One participant suggested making the home page brighter since other inspiring websites such as Pinterest and Behance are designed with bright and energetic colours.

Quantitative data

The SUS score and VisAWI-S score, which measured the usability and aesthetics of the interface, are calculated and displayed below.

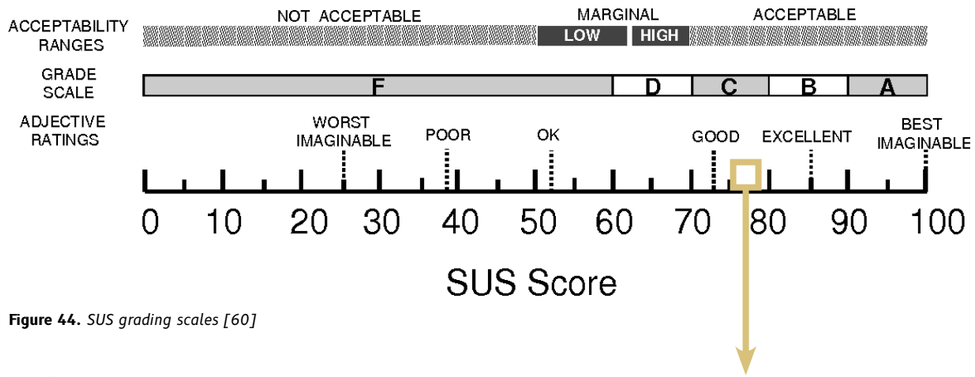


Figure 44. *SUS grading scales [60]*

The average SUS score from 500 studies is a 68 [61]. My prototype has a SUS score of **77.5** which is considered to be a good performance in the terms of usability.

ArtMind scored a 5.38 in general out of a possible seven. Figure 45 shows the score of each aspect. Craftsmanship got the highest score (5.8/7). According to the participants, Artmind has a **reliable** look and feel, matching the style of the museum. Diversity got the lowest score (4.7/7). Participants liked the simplicity of the website but they also felt that it was too **conservative**.

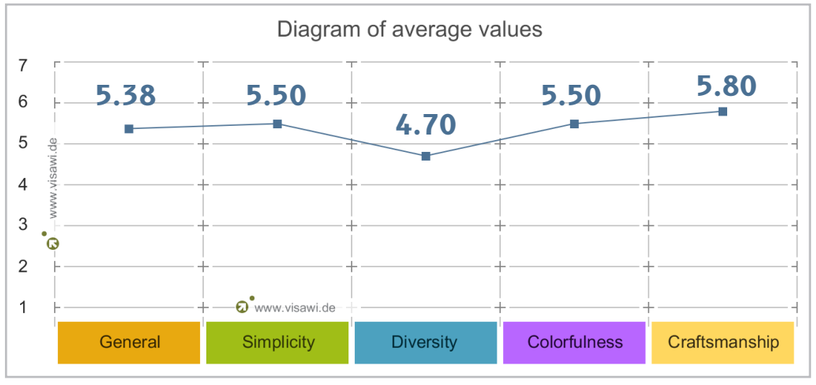


Figure 45. *Results of the VisAWI-S of ArtMind [www.visawi.de]*

[60] Reference
Xu, H., König, L., Cáliz, D. et al. A generic user interface for energy management in smart homes. *Energy Inform 1*, 55 (2018). https://doi.org/10.1186/s42162-018-0060-0

[61] Reference
Sauro, J. (2011). MeasuringU: Measuring Usability with the System Usability Scale (SUS). *Measuringu.com*. https://measuringu.com/sus/

5.7 Conclusion

In order to provide the most effective results for beginner artists while seeking inspiration, I combined the advantages of the three prototypes, MindMap, Sketch to Search and Style Analyser, for my final concept. Two new functions, adjusting the relatedness of outcomes and recommending similar works, were integrated into my final concept. The interface is redesigned in a way that unnecessary information is hidden by applying filter options. By doing so, the perceived information overload is minimized and users feel more in control while searching.

Furthermore, a usability test was conducted to evaluate the interface design. Test results showed that the interface was experienced as simple, elegant and reliable. Based on the SUS score, ArtMind could be considered as above the average. However, there are still some issues need to be improved. Some **quick fixes** of the interface are presented in the following pages.

Search results page - Quick Fixes

The ***home*** button is removed, because it feels more natural to get back to the home page by clicking on the logo.

The drop down filter is changed to a toggle button. In this way, users can directly see which options they have. These two options are reformulated as: **Closely-related** and **Distantly-related**.

To highlight the category of the **main search results,** its section on the page is larger than the other four categories, which are related to the search term.

In order to make the website look cleaner and more comfortable, the **color of the mask** on the images is changed to a more saturated and lighter brown and the **margin** between the sections is increased.

The ***undo*** and ***redo*** functions are placed next to the shuffle button to make it more clear that users can switch to the former or next related results.

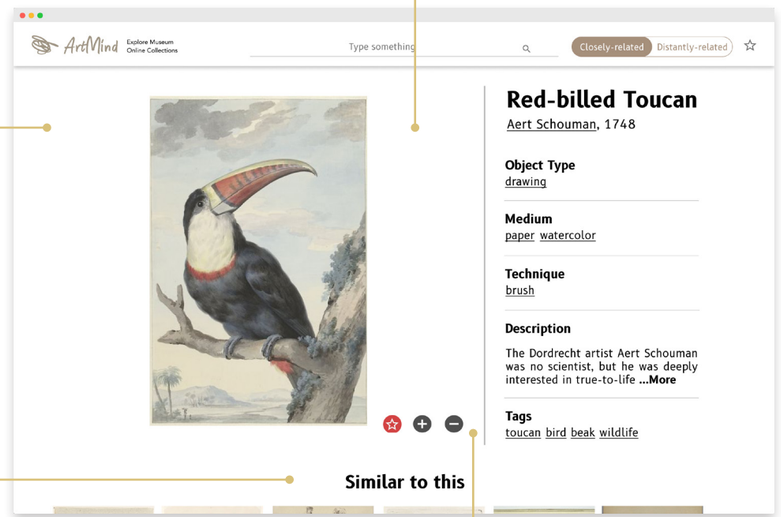
The ***shuffle*** icon is changed to a refresh icon because it is more familiar to the users based on the interview results.

Information page - Quick Fixes

The ***Back*** button is removed, because users are used to use the browser's back button to get back to the previous page.

The **background color** of this page is changed to white, because background color may influence the perception on artwork's colors [62].

[62] Reference
Color Contrast. (2015, December 3). *Exploratorium*. https://www.exploratorium.edu/snacks/color-contrast



The button that guides the users to ***similar works*** is not noticeable before. According to the feedback, it feels more natural to scroll down and get similar images directly, same as Pinterest and Google Images. Therefore, instead of using a button, a title 'Similar to this' is placed at the bottom of the page with the top of the images showing at the bottom edge of the page. This serves as a hint for users to scroll down further for similar works.

The ***Full-screen*** button is removed, because it makes more sense to click on the image to enter full-screen mode.

6 Final Concept

An iterated concept is created based on the insights I gained from the earlier phases. The final concept– ArtMind and its key functions, and working prototype made for user testing are explained and demonstrated in this chapter.

Link to the prototype:
https://artmind.
herokuapp.com/

6.1 Highlights of ArtMind

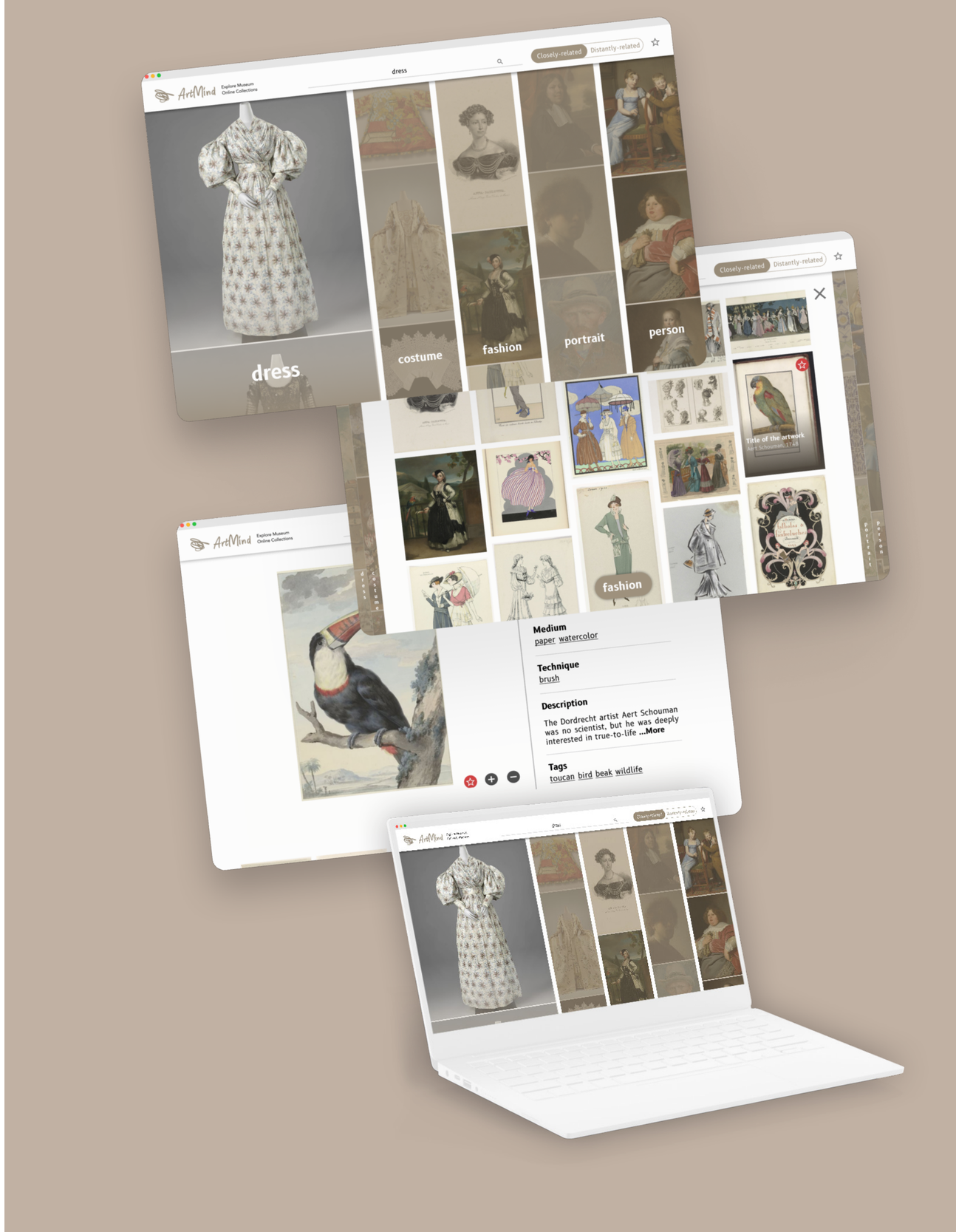
ArtMind is an online platform for beginner artists to explore the museum online collections and get inspired. It has four major features to inspire the users:

1. Based on the textual input from the users, ArtMind not only outputs artworks that are tagged with the search word but also shows four categories of artworks that relate to the search word. This feature is designed to lower the search threshold for users with a vague idea in mind. By offering associated results, users will be guided to explore their initial idea in different directions.

2. The user can adjust the relatedness of the search result to have more surprising outcomes that stimulate them to make abstract associations and generate new ideas.

3. By recommending artworks with similar aesthetic characteristics to the artwork in which they are interested, it assists users in clarifying their interests and narrowing down their creative directions.

4. During browsing the art collections, the user can collect interesting artworks for later study. This feature enables them to compare and combine the inspiration stimuli.



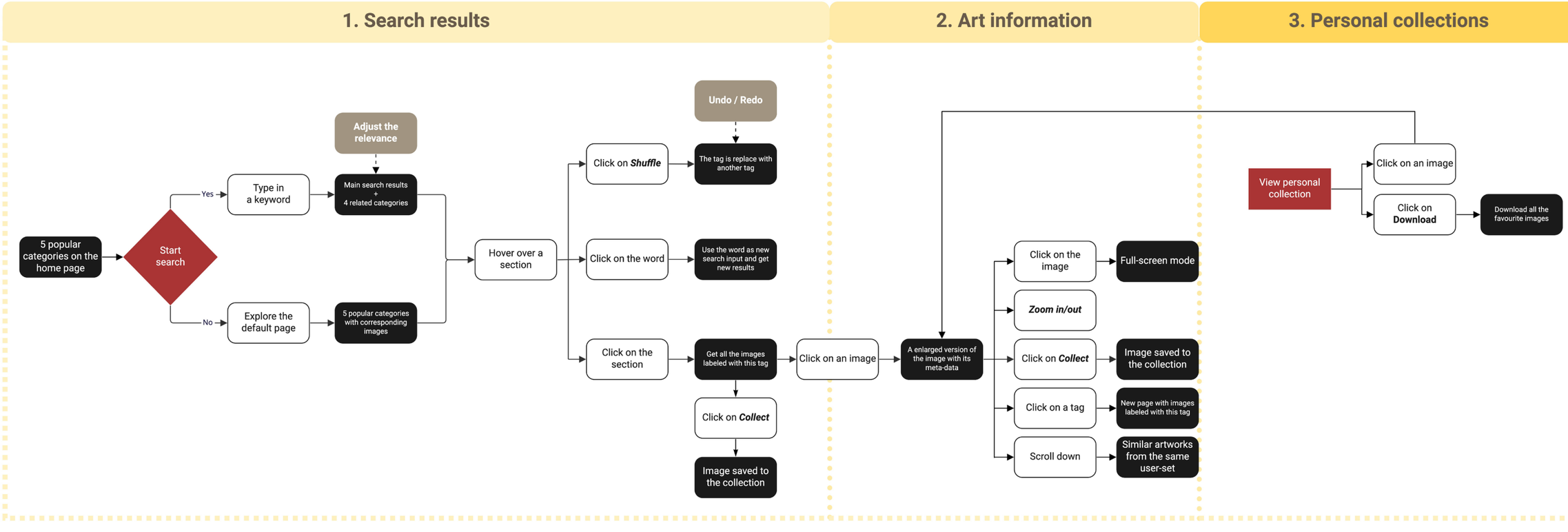


Figure 46. *Flow chart of the final concept ArtMind*

6.2 Use flow

In order to make users feel more confident while using this website, the user flow is simplified by eliminating unnecessary steps and buttons. ArtMind consists of three main functional pages: the search results page, the information page, and the pop-up window for reviewing personal collections.

The flowchart in Figure 46 demonstrates the main functions and steps of each page. Red represents the decisions users could make, white blocks are the possible actions that users can take, black represents the outcome of the respective action and the brown blocks are the supportive functions.

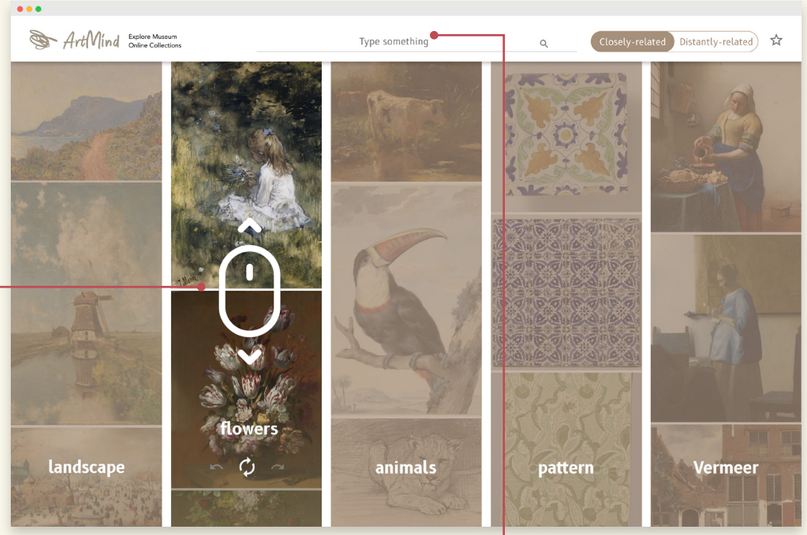
The final design is shown on the following pages, along with an explanation of its main features and interaction flows.

Home page / Search results page

Highlights of Rijksmuseum

On the default homepage, five popular themes of the Rijksmuseum's collections are displayed. They guide users through the museum's most famous works.

Scroll down on each section to see more artworks directly.

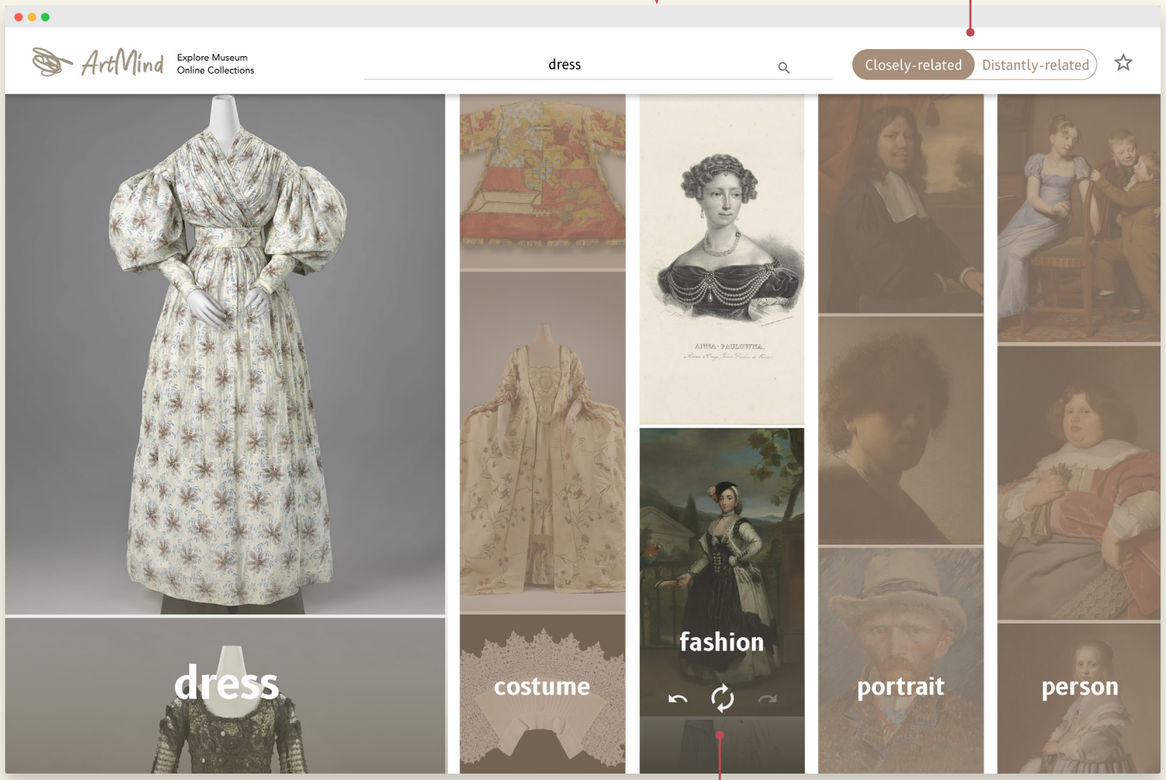


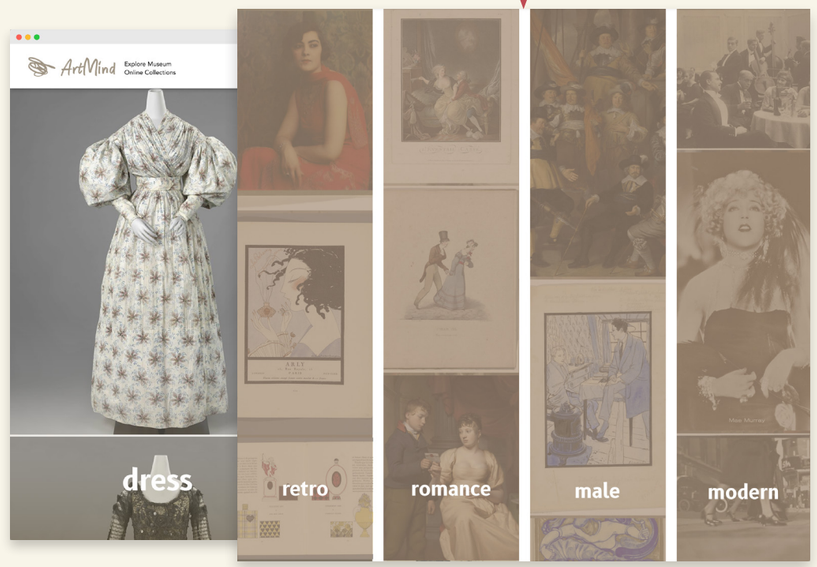
Adjustment of relatedness

Users can switch to the distantly-related mode in which they will get more surprising tags.

Related Search results

After entering a search keyword, users will get the main search results and four contextually related categories.



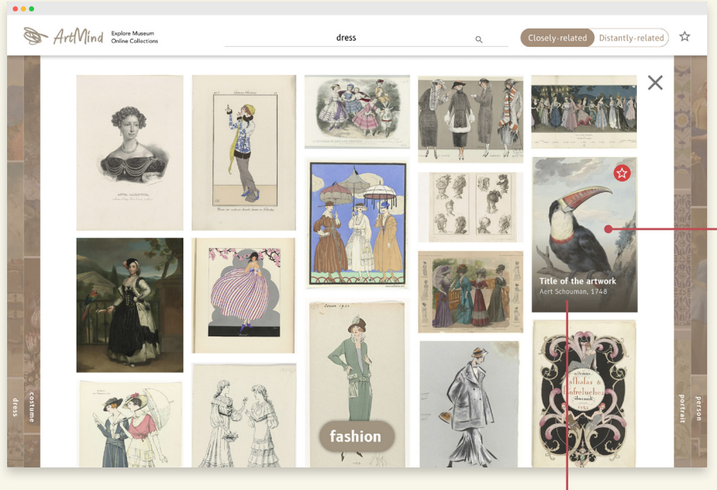


Shuffle the category

If one particular category is not interesting, users can click on the Refresh button to get another category. In the case of clicking by accident, an undo or redo of this action is possible.

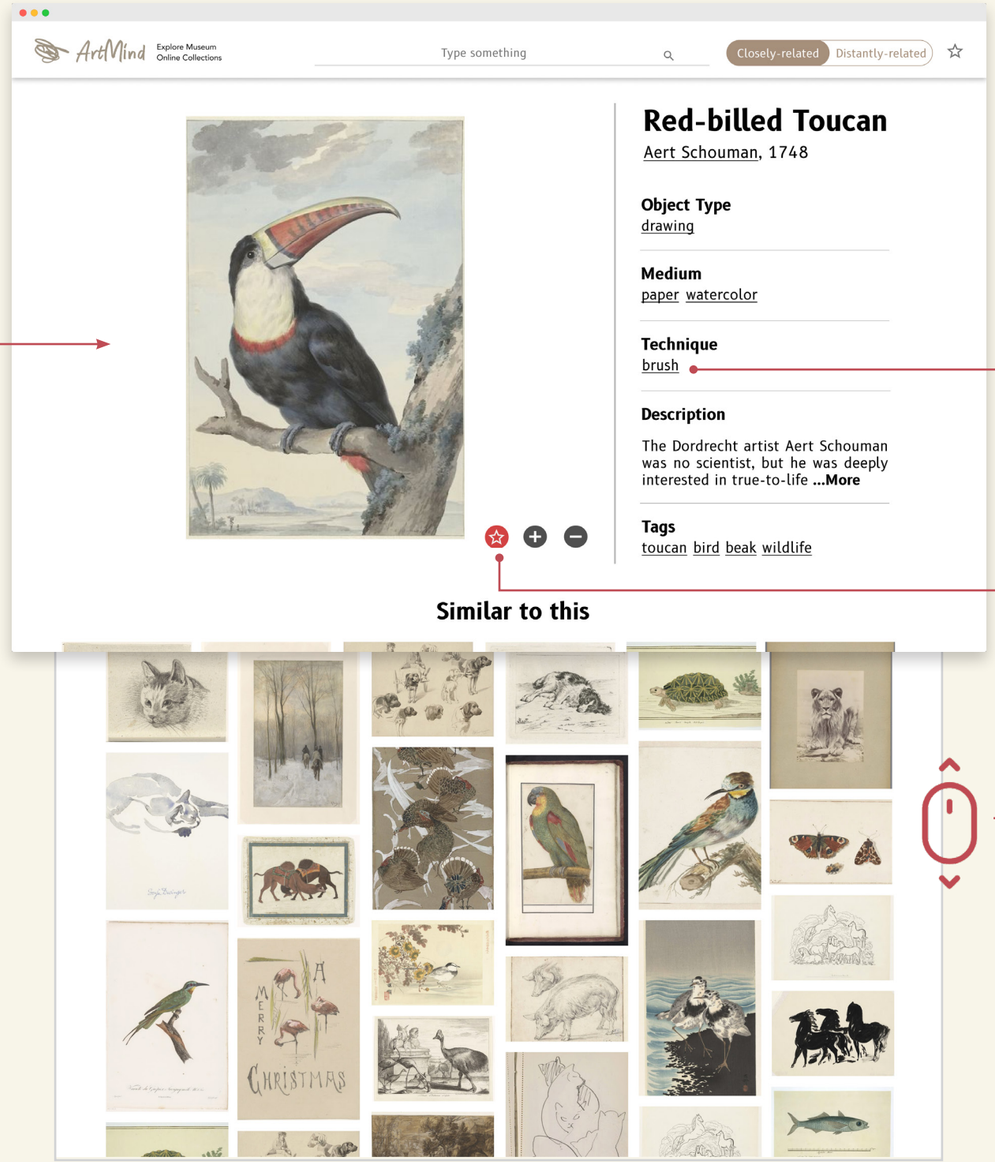
Figure 47. *ArtMind home page and search results page*

After clicking on the section, more images are displayed in an enlarged window.



Quick preview of the art

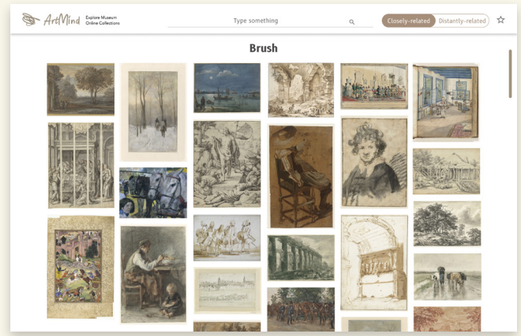
Hover over the image to see the title of this artwork and the name of the artist directly. It is also possible to collect the artwork at this stage.



Metadata of the art

Click on the image to get to the information page of the artwork. Learn more about the technique and media that were used to create this artwork.

Click on the tags to get more images labelled with the same technique.



Collect favourite art

Click this red button to save the artwork to personal collections.

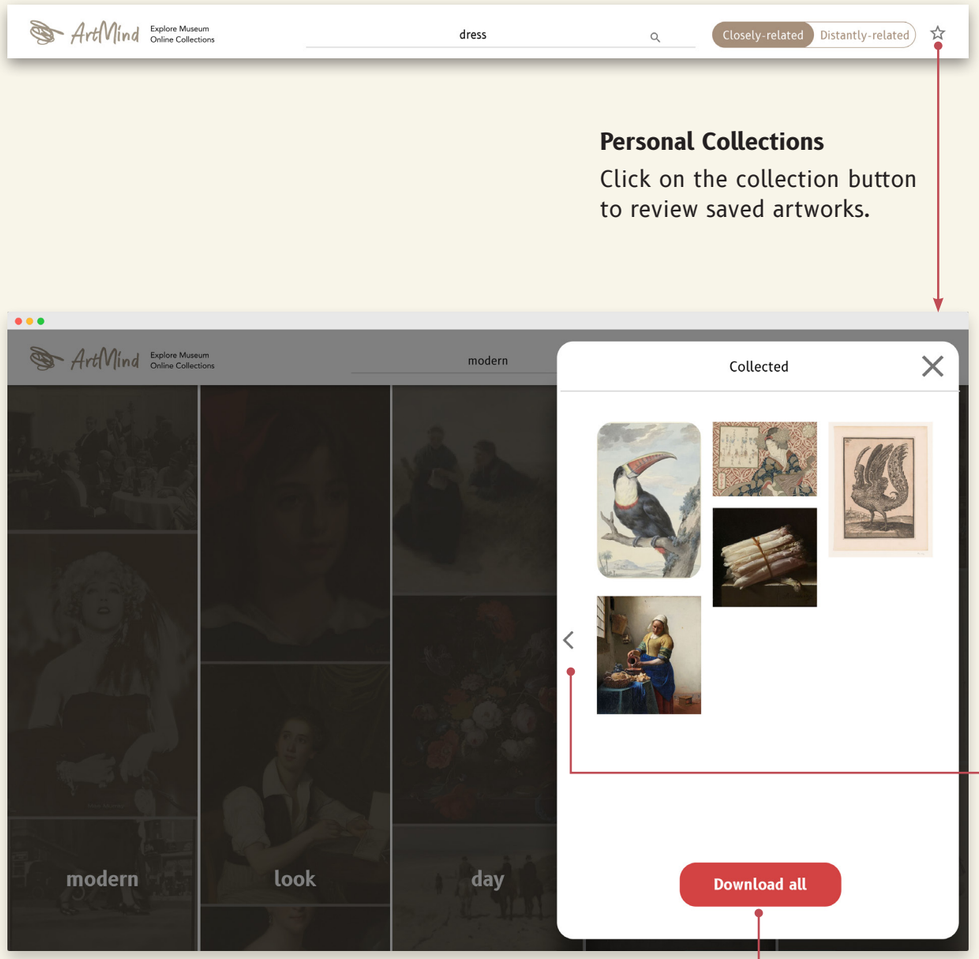
Similar works

Scroll down on the page to see recommended artworks with similar visual characteristics.

Figure 48. *ArtMind information page*

Information page

Collection pop-up

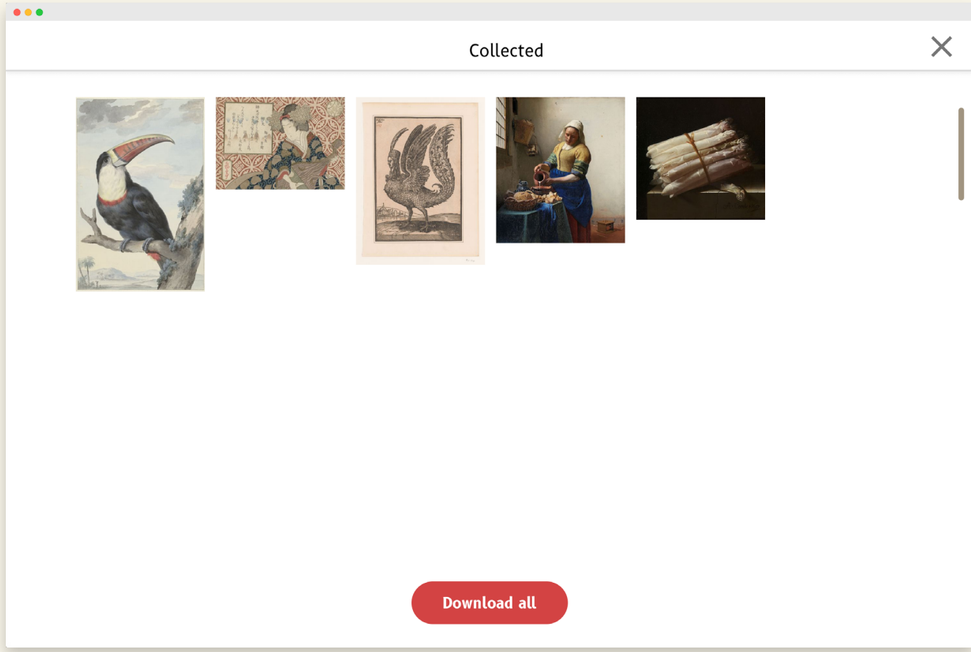


Personal Collections

Click on the collection button to review saved artworks.

Download images

Download favourite images for creative usage.



Enlarge the pop-up window to have a better overview.

Figure 49. *ArtMind personal collections page*

6.3 Working prototype

This section explains the decisions made for the final prototype and the working principle behind the prototype.

Function prioritization

Due to time constraints, I only implemented the features I wanted to evaluate. The prioritization of the functions was done by using the MoSCoW method [63]. In Figure 50, the functions that are highlighted in black are completed in my final prototype. The functions on white post-its are left out for now. For example, displaying corresponding information about the artwork is not the core of my concept, because the current museum websites also have this function. Since my prototype uses Rijksstudio's database, it will display the same information as Rijksstudio does. Therefore, I chose to leave it out by filling the information with place-holder text. Besides, browsers have their built-in zoom-in and zoom-out functions, therefore, I did not create an extra enlarge function in my prototype for testing. Due to lack of front-end knowledge, all the functions regarding the animations are left out for now. Besides, supportive functions that are not necessary for testing, such as undo and redo, are left out as well.

[63] Reference
Waters, K. [2009]. Prioritization using moscow. *Agile Planning*, 12, 31. https://comp.anu.edu.au/courses/comp3120/local_docs/readings/Prioritization_using_MoSCoW_AllAboutAgile.pdf

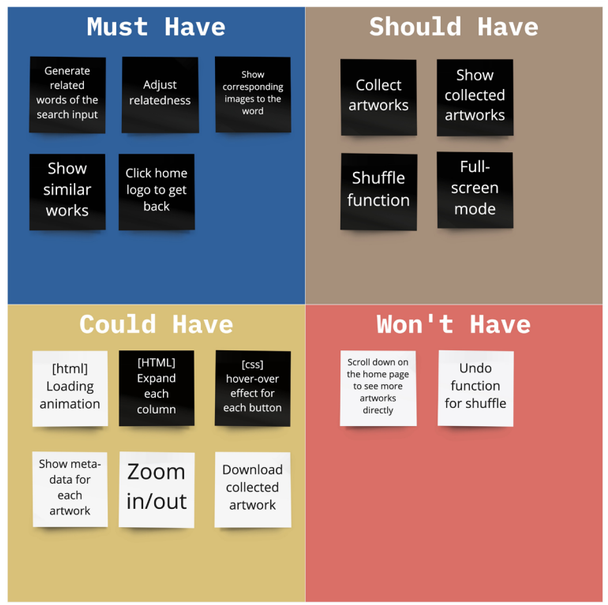


Figure 50. *MoSCoW prioritization*

AI & tools

The final prototype was built up with JavaScript in Visual Studio. The following APIs were used to create a working prototype.

Imagga API

During the user testing with prototype MindMap, I found that Datamuse API did not perform as well as I expected to generate related tags for the search keyword. Taking the word 'sea' as an example, Datamuse produces a variety of synonyms and terms with the same root word, such as 'ocean' and 'oceanic'.

However, the idea of my concept is to provide users with associated tags that help them imagine different scenarios. Related tags for 'sea' could be 'summer', 'children', 'sand castle', etc. As a result, I switched to another tool in my final prototype. With the help of Imagga Image Auto Tagging technology [64], images can be automatically assigned with relevant tags or keywords. The machine learning model for image tagging analyzes the pixel information in images, extracts their features, and identifies possible items. This model is trained by using more than 3000 real-world objects.

[64] Tool
Imagga
https://imagga.com/

Figure 51. *Painting Children of the sea*

By analyzing the piece of art which best represents the search term, Imagga helped me generate contextually relevant tags. This method effectively simulated the outcome I was going for. For the search query 'sea', the painting Children of the sea was the most relevant result (Figure 51). After analyzing its image by using Imagga, related tags are generated as shown in Figure 52. Tags such as 'sand', 'summer', and 'vacation', are the associated tags my concept aimed to offer.

Figure 52. *Comparison between the AI-generated related tags.*

Rijksstudio User-generated Content

The JSON file with the information of 163,862 user-sets was used to generated a recommendation system for similar artworks.

To reduce the file size and therefore improve the performance of the prototype, a smaller CSV file was created, with each row representing a user-set which only contains object numbers of the artworks that are collected in the sets. With this CSV file, the images that are saved in the same user-set as the query image can be retrieved more easily.

Rijksstudio User-generated Content

Rijksstudio's metadata API was used for retrieving object numbers of the most relevant artworks for the search query.

Wikimedia Commons API

Displaying artworks in original sizes caused too many lags while using the prototype. Therefore, the Wikimedia Commons API is utilized to obtain a smaller size of the artwork from Rijksstudio.

Back-end Design

The working principles of ArtMind's core functions are shown below.

Related Search results
Users' search query is used to retrieve the most relevant artwork from Rijksstudio's API. This artwork is analysed by Imagga and a list of related tags that are ordered by the confidence score is generated. The relevant images of each tag are obtained from Rijksstudio's metadata API. After that, Wikimedia API is used for shrinking the size of the image. Finally, the configured image URLs are loaded and displayed on the interface by using JavaScript.

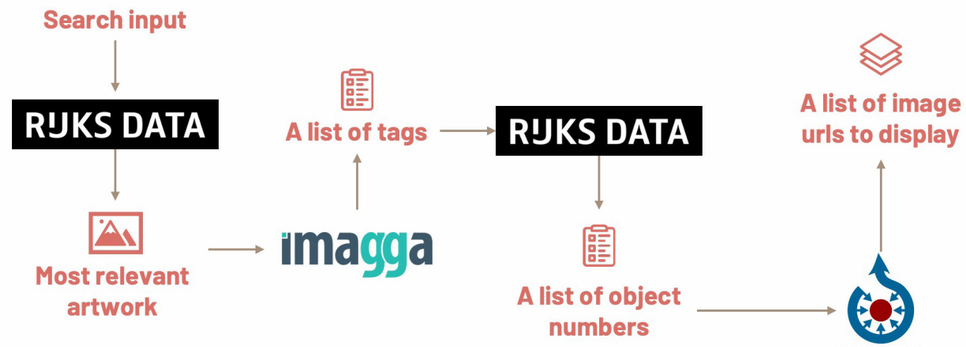


Figure 53. *Back-end design of getting related search results*

Similar works
After clicking on a piece of art, its similar works will be collected and displayed on the interface. To do so, the object number of this artwork is used to locate all user-sets that contain it. After that, co-occurring artworks in these user-sets are randomly selected and displayed on the interface as similar works.

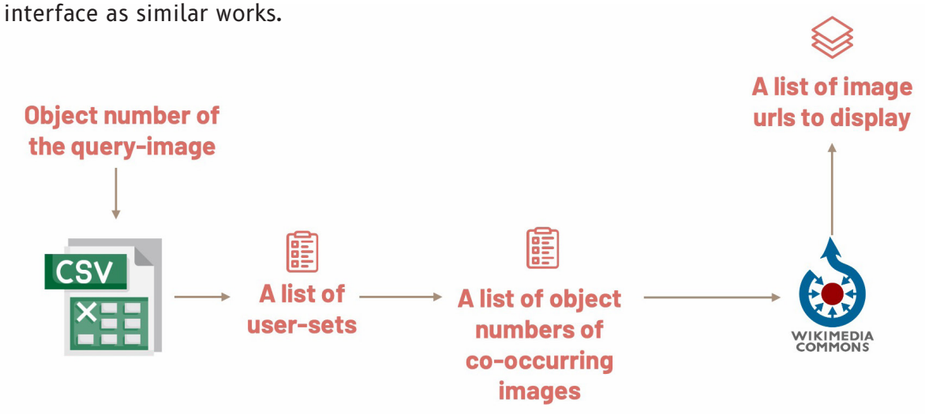
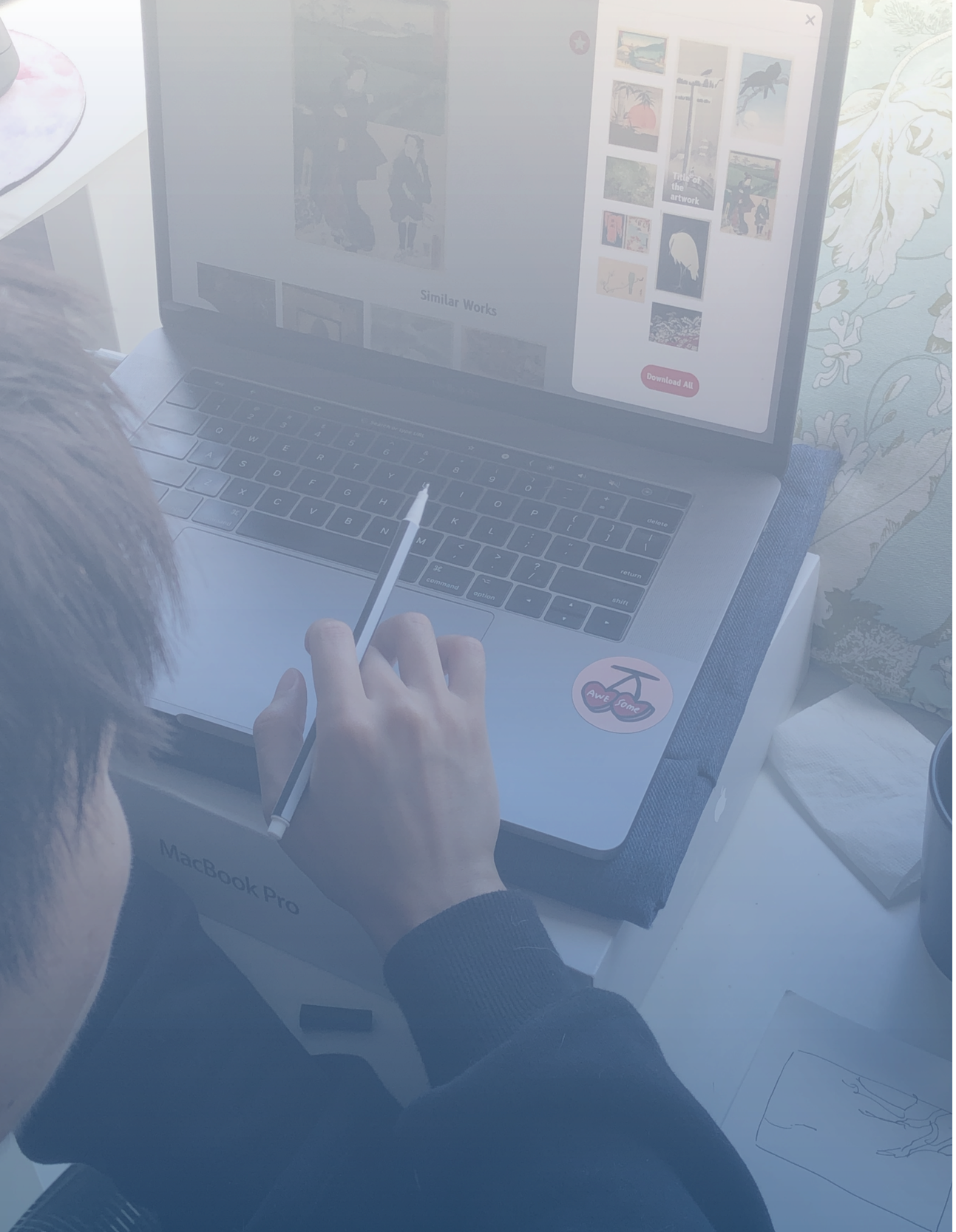


Figure 54. *Back-end design of recommending similar works*



7 Evaluation & Recommendations

In the previous chapters, a design solution was proposed. The working prototype of it enables me to perform an evaluation test. In this chapter, the results of the user tests are discussed, followed by recommendations for future research and a personal reflection.

7.1 Test Set-up

Goal

The goal of the evaluation test was to assess whether my design solution has met the design goal and desired interaction. Therefore, the following question should be answered through user testing:

How does my concept help novice artists seek inspiration in museum online collections?

The three desired interaction qualities, **guiding**, **resonating**, and **encouraging** were used as metrics to evaluate the desired interaction with my design.

Participants

Ten participants were recruited through convenience sampling. They were all novice artists who started a maximum of one year with their creative activity or those who see art as a hobby. The frequency of creation differs from daily to semi-annually.

Procedure

The user test included the following four parts:

1. Interview about art experience and interests in museum online collections
2. Assignment for participants to seek inspiration for 'farm' on ArtMind
3. Interview about the experience with ArtMind
4. Questionnaire to conclude the experience with ArtMind

Due to technical limitations of my prototype, participants can not get response for all the words they entered. After trying out several different keywords for search, I found that the related results of 'farm' were close to what I desired. Thus, an assignment was formulated for the participants as using "farm" as the direction of their creative purpose.

A pilot test was conducted to ensure that the process runs smoothly. To guarantee that instructions to everyone were the same, a session script was used to guide participants through the test. [Appendix I].

Methods for data collection

During the user tests, a number of techniques were used to collect data. Thinking out loud, interviews and observations were used to collect qualitative data. Attrakdiff was used to collect qualitative data.

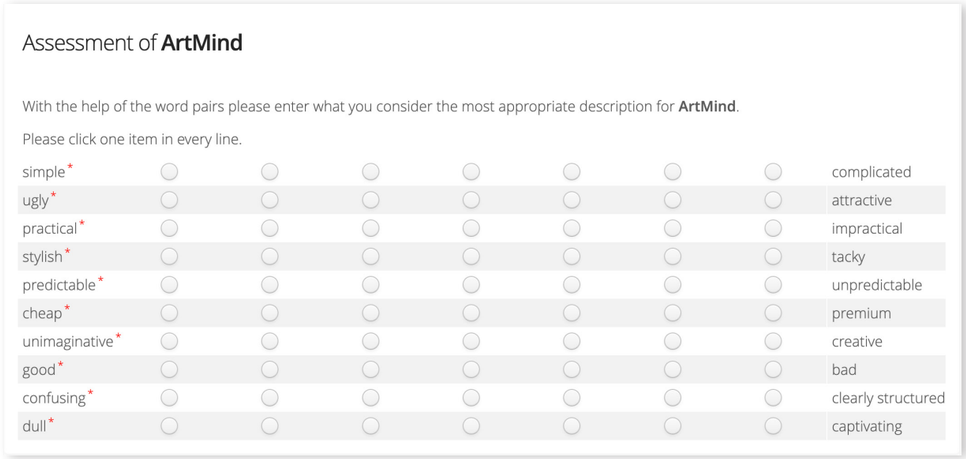
Thinking out loud
Participants were asked to share their thoughts for each step and each page while using ArtMind.

Observing
Participants' actions were screen-recorded. Their unexpected actions and remarks were noted down.

Interview
Before and after the assignment of seeking inspiration on ArtMind, participants were asked to reflect on their creative experiences. Besides, they were asked to evaluate to what extent the three interaction qualities were achieved.

Attrakdiff-Short [65]
To measure how attractive the product is in terms of usability and appearance, a shortened version of AttrakDiff is used. It allows users to anonymously evaluate the product or service. Attrakdiff-short consists of ten opposite adjectives [e.g. "confusing - clear", "predictable - unpredictable", "good - bad"]. A seven-point intensity scale is used to rank each group of adjective elements [Figure 55].

[65] Reference
Attrakdiff
https://attrakdiff.de/


Assessment of **ArtMind**

With the help of the word pairs please enter what you consider the most appropriate description for **ArtMind**.

Please click one item in every line.

simple *	○	○	○	○	○	○	○	complicated
ugly *	○	○	○	○	○	○	○	attractive
practical *	○	○	○	○	○	○	○	impractical
stylish *	○	○	○	○	○	○	○	tacky
predictable *	○	○	○	○	○	○	○	unpredictable
cheap *	○	○	○	○	○	○	○	premium
unimaginative *	○	○	○	○	○	○	○	creative
good *	○	○	○	○	○	○	○	bad
confusing *	○	○	○	○	○	○	○	clearly structured
dull *	○	○	○	○	○	○	○	captivating

Figure 55. *Attrakdiff questionnaire*

7.2 Results

In order to get an overview of the test results, qualitative data such as the notes of thinking out loud and interviews were clustered into a Plus-Minus-Interesting table, which can be found in Appendix J. The quantitative data–the Attrakdiff scores–were plotted in a diagram.

Qualitative Data

Important insights and quotes gathered from interviews were summarised for each interaction quality to evaluate to what extent my design achieve the desired interactions.

Guiding

Participants (7/10) appreciated the **variety** ArtMind gave at the stage of randomly searching. The suggested tags by Imagga **guided** them to related directions of their initial idea. A concept direction could be formed while browsing these categories.

> "I searched for 'countryside' and it gave me sections of weather, people, and animals. very rich search results. -P3

Due to the limitations of the current tool, suggested tags were not always relevant to the search query. It could be **difficult** for users to see the connections between different categories. Some participants got **confused** about the search results because they did not get a direct response to the search input. ArtMind did not meet the needs of those who required specific inspirational stimuli.

> "It didn't help me explore my search query. It suggests things that might be interesting to me, but not what I want. There is too much unrelated stuff. -P4

In addition, participants had the impression that the images were not well sorted. For example, some portraits were displayed in the category of landscape, as shown in Figure 56. Although these artworks are related to the landscape in some way, the low relevance of these images might **distract** them while finding inspiration.

> "It offers too many different types of art at once. It distracts me more rather than guides me. -P1

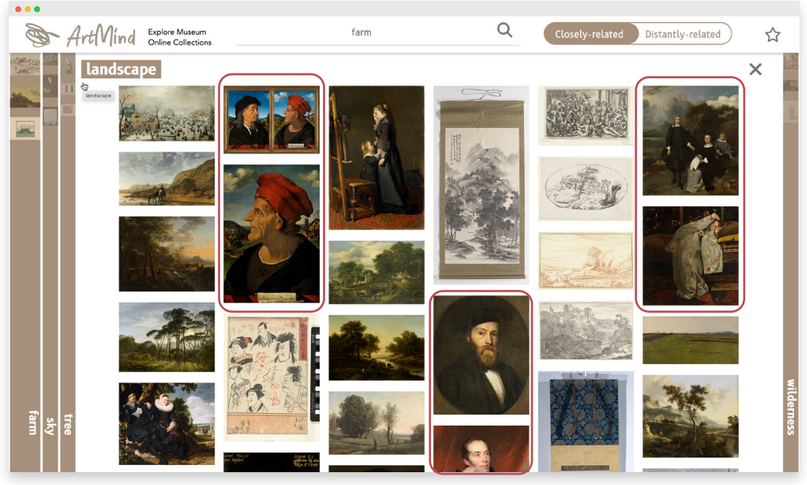


Figure 56. *Examples of unrelated artworks in the category Landscape*

Resonating

Participants (6/10) experienced **difficulty** in feeling the desired vibe with my concept. As shown in Figure 57, the recommended similar works did not always in line with the style of the artwork above. Users expected artworks with similar color palettes or **similar artistic styles**.

> The results are not relevant so it directs me to different paths, it's hard to gradually find elements that fit together
> -P5

> On the homepage, I already saw a lot of farms, so on this information page, I expected to learn more about the style and artist.
> -P8

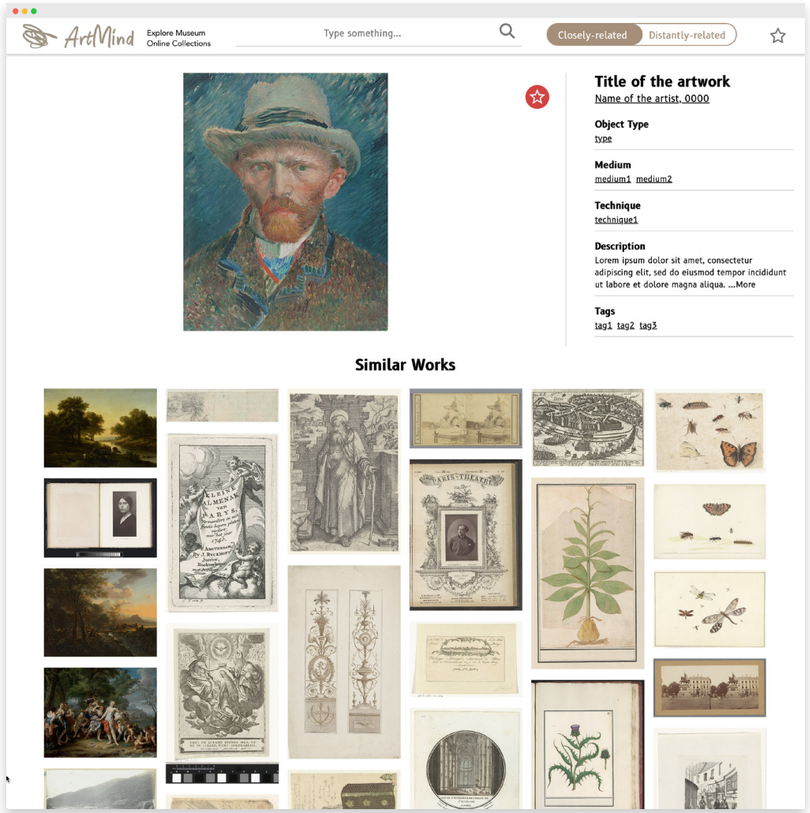


Figure 57. *Examples of unrelated artworks in similar works*

The randomness in similar works could **interrupt** users' thinking flow. Ideally, they would like to keep clicking through interesting images until they discovered their real interest.

On the other hand, two participants appreciated the diversity in similar works. New ideas sparked out during browsing the unexpected outcomes. It allowed them to make **surprising combinations**. According to them, similar works that ArtMind offered were more helpful and inspiring than the recommendations Pinterest provided.

In addition, the related categories displayed together with the search results could help users get an **overall impression** of the search topic and build up their imaginary scenes.

> Irrelevant works in similar works interrupt my thoughts and I have to go back to the home page to search for some new words to continue the ideas I had.
> -P9

> I switch to distantly related results to get a more abstract view of the farm and to imagine how my farm might feel like.
> -P10

> I was gradually drawn to plants and animals, and tended to combine these elements. The randomly recommended similar works helped me explore what I really liked. -P1

Encouraging

According to participants, ArtMind **encouraged** them to generate more creative ideas through divergent thinking. However, they might need to switch to other platforms to study specific styles or elements in order to refine their concept.

Furthermore, all the participants said that the function of creating personal collections enabled them to review their favourite artworks. A concrete concept could be developed at this stage.

> This website continuously encourages me to think more broadly. Once I have my concept, I will switch to Google Image to get more specific information.
> -P6

> I will make some sketches based on my favourite works. -P8

Quantitative Data

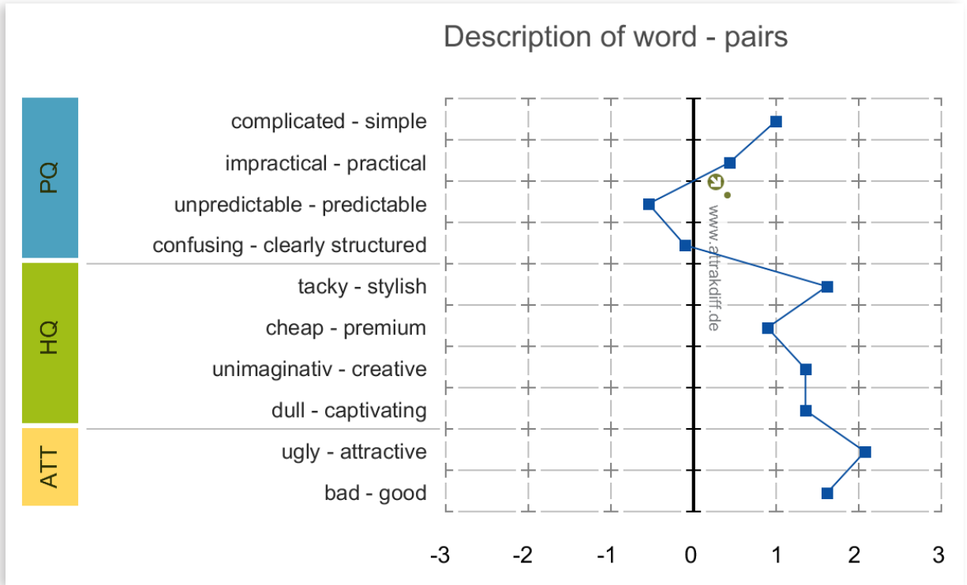


Figure 58. *Results of Attrakdiff-Short*

Pragmatic Quality (PQ)

PQ, pragmatic qualities represent ArtMind's usefulness. ArtMind was experienced as ***simple*** and ***practical***, but also ***unpredictable*** and ***confusing***. According to participants, ArtMind did help them find inspiration and guided them to explore museum collections. The negative scores on the last two components are mainly caused by the irrelevancy of the outcomes. A low PQ score means that it is not effective and efficient for users to find inspiration.

Hedonic Quality (HQ)

HQ, hedonic qualities measure the perceived stimulation or excitement when using ArtMind. ArtMind was perceived as ***stylish***, ***premium***, ***creative*** and ***captivating***. A high HQ score indicates that ArtMind can stimulate the user to use it. According to participants, the biggest difference between Google and ArtMind is that ArtMind guarantees high-quality images. During the interview, all of them expressed their appreciation for the user interface's clarity and simplicity.

Attractiveness (ATT)

ATT, attractiveness shows how desirable ArtMind is. Studies showed that attractiveness is affected by pragmatic and hedonic qualities [66]. ArtMind received a score of ***1.86*** out of 3 for attractiveness. It scored above the mean, however, it would perform better if the algorithms were improved to make the results more on point.

[66] Reference
Schrepp, M., Held, T., & Laugwitz, B. [2006]. The influence of hedonic quality on the attractiveness of user interfaces of business management software. *Interacting with Computers*, *18*[5], 1055–1069. https://doi.org/10.1016/j.intcom.2006.01.002

7.3 Conclusion

In order to evaluate the outcomes of the project, I referred back to my design goal—help novice artists seek inspiration in online collections.

How does my concept achieve the design goal?

According to participants, ArtMind provided a different inspirational path. It was less efficient and more twisted, but it extended users' thinking pathways and led to more original outcomes.

Users described my design as an associated search tool. The related search results enabled them to diverge their ideas. They were **guided** to explore surprising inspirational stimuli. Additionally, they could narrow down their directions by browsing through recommended artworks with similar visual characteristics that **resonate** with their desired feeling. Finally, they were **encouraged** to create art based on their favourite artworks.

In general, participants liked the vision of this concept, which is that AI thinks with the user. However, the current way of interacting with AI is not transparent. The related results generated by the AI were confusing for most participants. At the same time, these random suggestions could help them get inspired in an indirect way. A future iteration of my concept will be exploring different ways of communicating with AI.

7.4 Discussion & Recommendations

The limitations of this project are discussed in this part. In addition, recommendations regarding future research and development of the concept are formulated.

Different needs

During the interview, participants were asked to describe their final ideas which are derived from the initial idea of 'farm'. Interesting conclusions were drawn from their outcomes. The recognizability of the farm in their concepts differed. The reason for this could be different interpretations of my assignment —using "farm" as the direction of the creative purpose.

One group of people used "farm" to define the scope of their work. They built up a scene of the farm. Topics such as vegetables, clothing of the farmer, and types of animals were what they preferred to see while using ArtMind. This group of people had feedback that ArtMind did not meet their search needs.

For another group of people, the farm was used as a starting point of their inspirational route. From "farm" they could be directed to more broad topics such as "sun", "birds" or "plants". "Farm" was used as abstract inspiration. These people valued the variety of the collections ArtMind provided.

From these results, two different needs were identified:

1. **Random Search**
   The search results are expected to be related but also unexpected. Examples of abstract results of the farm could be *sunlight*, *sky*, and *cliff*.

2. **Specific Search**
   The search results are expected to be detailed and directly related. Examples of specific results of the farm could be *farmers*, *cows*, and *vegetables*.

Limitations

There were a number of limitations that affected the outcomes of the user study.

Firstly, the available tools did not fully simulate the desired functions. The current open-sourced technology is not intelligent enough to define the context of a word and the elements that frequently accompany it. In addition, it was difficult to preset the suggestions, since everyone follows a unique inspirational route. Therefore, participants were confused by this function due to the low relevance of suggested categories. This is also the case with the simplified recommendation system of similar works. The simulated outcomes fell short of expectations and resulted in negative feedback on the concept.

Secondly, not all the participants have time to complete their inspirational journey on ArtMind. Three of them did not develop a concept due to time constraints. Their creative outcomes would be useful for analyzing their needs.

Future work

From the results and analysis discussed in previous sections, the following suggestions for future research and development are listed below:

Associated searching

The core function of my concept is using AI to provide associated results. Different levels of abstraction are needed depending on users' needs. The challenge for the future will be classifying the relatedness of AI-generated tags clearly. One solution could be allowing users to add related tags to the system. These user-generated data can be used to train the algorithms.

During the interview, it has been found that users required more communication with AI for getting the most effective search results. One suggestion could be allowing the system to ask extended questions about users' search query and refine their search according to the answers. For example, a style quiz can be used to detect users' favourite art styles.

Recommendation system

In order to improve the relevance of the suggested similar works, filters could be applied to guarantee that only artworks with the same object type and the same

genre of the query image will be displayed. Machine learning could be used to determine the relevance of related works in the same way that Pinterest does.

One participants suggested to make the toggle switch working for adjusting the relatedness level of similar works. Closely-related option for only showing the artworks with high relevance, just like the recommendations of Pinterest. And the distantly-related option for showing diverse artworks just like ArtMind now does.

Other ways to help users study their artworks

Throughout my project, I mainly focused on the shaping and feeling parts of the inspirational process. I did not have time to explore the studying stage, but there are a lot of possibilities to improve the online art-viewing experience.

During the brainstorm session, a number of ideas were generated:

- Creating virtual gallery of favourite artworks
- Immersive experience–step into the art
- Viewing the artworks in 3D
- Having a virtual chat with the painter

Expand the online collections

During the interview, almost all the participants mentioned that it would be nice to see some modern art collections from museums, such as Stedelijke museum and Tate Modern. Ideally, there should be an online platform that contains online art collections from all over the world.

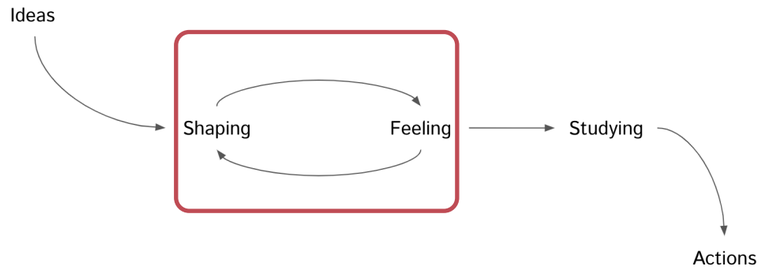


Figure 59. *Design focus throughout the project*

7.5 Personal Reflection

Now I have reached the end of my project and it is time to refer back to my personal goals that were set at the beginning of this project.

Firstly, I wanted to develop my existing technical skills relating to coding and prototyping. Throughout this project, I learnt to code with JavaScript, HTML and CSS. In addition, I also learnt to work with GitHub and built a personal website with it. I had no prior experience with front-end design, but I have built a website as my final prototype.

During the exploration phase, I gained a basic knowledge of the recommendation algorithms and neural networks. Besides, I experimented with several open-sourced machine learning libraries, such as Imagga, Huggingface and FaceAPI and integrated them into my prototypes. By doing so, I got a better understanding of the existing technologies and possibilities.

The second learning goal was to work with different data structures. During prototyping, I learnt to retrieve data from different APIs and organize different types of data.

Another personal goal was to strengthen the project management skills, which was the most challenging one during this project. Unwanted errors were appearing during prototyping. It was difficult to meet all the deadlines I have planned. This could cause delays in the other plans. Moreover, conducting user test on my own was not easy. Especially, if I needed to observe and made notes at the same time. Therefore, it was important to make a test set-up in advance.

Working on this project was enjoyable for me, and I am confident that I met my personal learning goals.

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Master Thesis
Design for Interaction