

# Interactive Design of Gallery Walls via Mixed Reality

## Supplementary Material

### 1 Templates

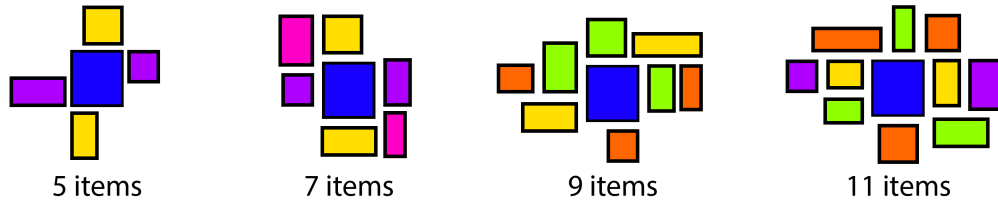


Figure 1: The templates we use in our system. The blue item represents the focal item. The colored items represent the groups of 2 or 3 auxiliary items.

### 2 Interview with Designers on Workflow

To devise a computational approach and a practical tool for designing gallery walls, we interviewed 4 professional designers from a large furnishings and décor company to better understand the way professional designers create gallery walls under current practice. Each of the designers has at least 5 years of interior design or staging experience and has designed dozens of gallery walls in their professional capacity.

Figure 2 shows a gallery wall created by a designer. The general process of designing a gallery wall is as follows: 1) observes the style of the room, 2) explores a database and chooses a focal art item, 3) selects and adds the auxiliary art items that the colors and styles are compatible with the focal art item, 4) refines the art items.

1. The designer first observes the style of the room, particularly paying attention to the colors of the wall and the furniture objects that the designer would like to decorate around.
2. The designer explores a database containing many art items and chooses a focal art item, which is to be placed near the center of the gallery wall and serves as the reference for placing other auxiliary art items. The color of the focal art item should be compatible with the wall color.
3. The designer selects and adds the auxiliary art items to the gallery wall. The colors and styles of these art items should contain some variety, yet they should all be compatible with those of the focal art item.
4. The designer lays out the auxiliary art items around the focal art item nicely. One common consideration is balance: pairs of similar art items are placed at opposite sides of the focal art item.
5. The designer refines the locations of the art items to achieve proper spacing and alignment between items.



Figure 2: A gallery wall created by a designer using a conventional workflow. The focal item (in yellow), as well as a diagonal pair (in orange) and a triangular group (in cyan) of auxiliary items are highlighted.

### 3 Tags

#### Tags: Style

American Traditional	Asian Inspired	Beachy	Bohemian & Bold	Eclectic Modern
Cabin / Lodge	Coastal	Cottage / Country	Cottage Americana	Eclectic
French Country	Glam	Global Inspired	Industrial	Mid-Century Modern
Modern & Contemporary	Modern Farmhouse	Modern Rustic	Nautical	Ornate Glam
Ornate Traditional	Posh & Luxe	Rustic	Scandinavian	Sleek & Chic Modern
Traditional	Tropical			

#### Tags: Subject

Abstract	Abstract	Bath & Laundry	Buildings & Cityscapes	Cities & Countries
Entertainment	Fantasy & Sci-Fi	Fashion	Floral & Botanical	Food & Beverage
Geometric	Humor	Inspirational Quotes & Sayings	Landscape & Nature	Maps
Nautical & Beach	People	Spiritual & Religious	Sports & Sports Teams	Transportation

#### Tags: Color

Beige	Black	Blue	Brown	Chrome
Clear	Gold	Gray	Green	Orange
Pink	Purple	Red	Silver	Tan
White	Yellow			

Table 1: The tags in our database, which are manually assigned to the art items by professional designers. The database consists of 3 categories, namely, style (27 tags), subject (20 tags), and color (17 tags).

## 4 Data Analysis

Table 2 shows the summary of performance results of Group 1 and Group 2. Table 3 shows the summary of usage statistics of Group 1 and Group 2. Individual data of all 41 participants can be found in the submitted Excel document **individual\_data.xlsx**.

Performance Result: Group 1					Performance Result: Group 2				
		Mean	SD	p-value		Mean	SD	p-value	
Number of Click	MR	39.88	11.77	<b>&lt;0.01</b>	2D	38.67	20.14	<b>&lt;0.01</b>	
	2D	70.71	25.3		2DNT	55.04	35.60		
Number of Movements	MR	24.82	11.54	<b>0.04</b>	2D	27.04	26.89	0.5	
	2D	32.59	15.80		2DNT	22.80	39.6		

Table 2: Performance results of Group 1 and Group 2. MR refers to mixed reality, 2D refers to 2D interface with template, and 2DNT refers to 2D interface with no template.

Usage statistics: Group 1					Usage statistics: Group 2				
		Mean	SD	p-value		Mean	SD	p-value	
Temp. Item Removed	MR	19.51%	17.89%	0.53	2D	25.37%	24.41%	N/A	
	2D	28.19%	33.44%		2DNT	N/A	N/A		
Temp. Item Resized	MR	12.19%	15.53%	0.43	2D	6.82%	14.73%	N/A	
	2D	7.67%	11.49%		2DNT	N/A	N/A		
Suggested Item Usage	MR	82.40%	19.85%	0.34	2D	75.27%	20.06%	<b>&lt;0.01</b>	
	2D	76.21%	24.83%		2DNT	59.84%	21.86%		
Select Item's Rank	MR	10.25	3.52	0.52	2D	9.74	4.68	0.35	
	2D	9.64	2.86		2DNT	8.67	3.69		

Table 3: Usage statistics of Group 1 and Group 2. MR refers to mixed reality, 2D refers to 2D interface with template, and 2DNT refers to 2D interface with no template.

Questionnaire Responses: Group 1				
		Mean	SD	p-value
Confidence of aesthetics	MR	3.35	0.86	0.84
	2D	3.41	0.80	
Confidence of dimensions	MR	4	1.06	0.56
	2D	3.76	1.09	
Suggestion engine useful	MR	3.80	0.88	0.38
	2D	4	0.71	
Easy to use	MR	3.23	1.03	<b>&lt;0.01</b>
	2D	4.35	0.61	
Comfortable	MR	2.58	1.58	<b>&lt;0.01</b>
	2D	4.11	0.80	

Table 4: Questionnaire responses of Group 1. MR refers to mixed reality. 2D refers to 2D interface with template.

## 5 System Performance

We tracked the performance of retrieving items from the large database we used in our experiments on a desktop computer equipped with a i7-7700K 4.2GHz CPU, 16GB RAM, and an NVIDIA GeForce GTX 1080 8GB graphics card. Retrieving focal items took 3.12 seconds and retrieving auxiliary items took 1.21 seconds. All the other user interface operations ran at an interactive rate.

## 6 3D Model Example

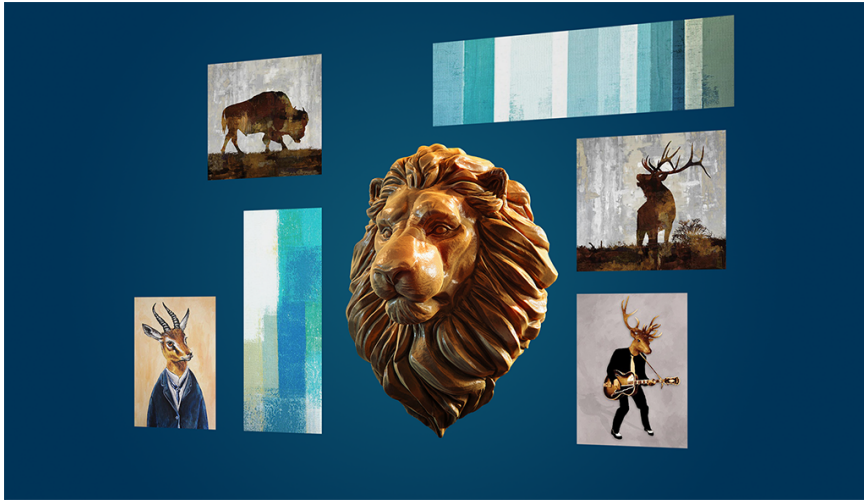


Figure 3: Example of a gallery wall design containing a 3D decoration object (a lion head) that can be visualized in mixed reality using our tool.

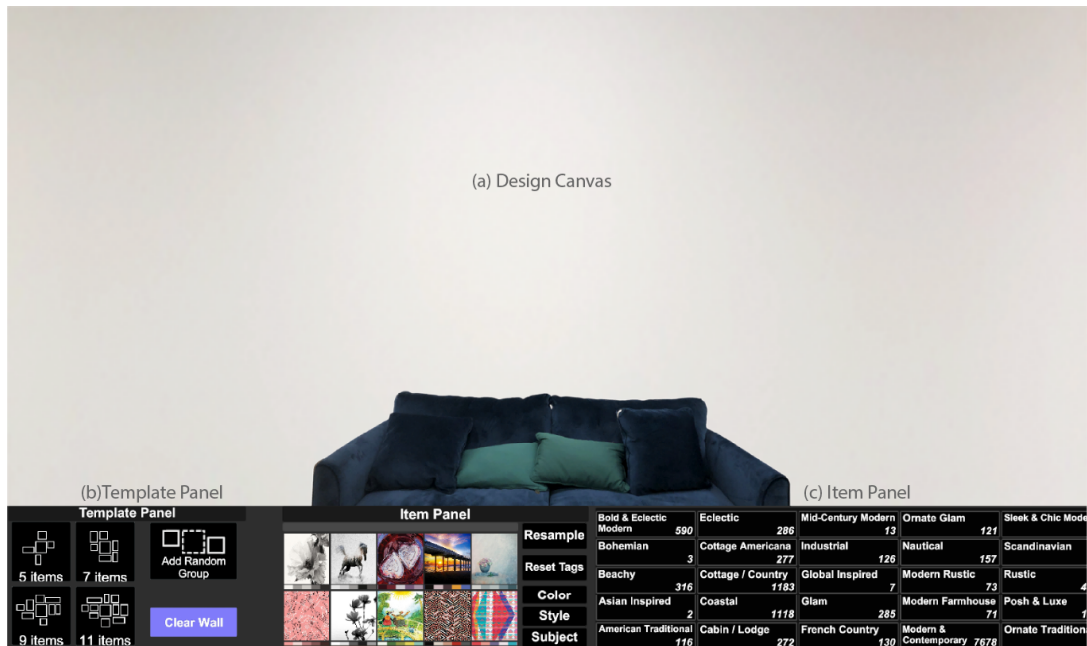
## 7 User Study

To evaluate our approach, we conducted an IRB-approved user study with 41 participants. Group 1 was recruited to evaluate the user experience of designing a gallery wall using our mixed reality interface based on Magic Leap One versus using a 2D interface which mimics a traditional design tool on a laptop. We recruited 17 participants, consisting of 13 males and 5 females, aged between 20 to 45. Group 2 was recruited to evaluate the user experience of designing a gallery wall with and without the template functionality. We recruited 24 participants, consisting of 16 males and 8 females, aged between 19 to 24. The designs created by the participants can be found in the submitted document:

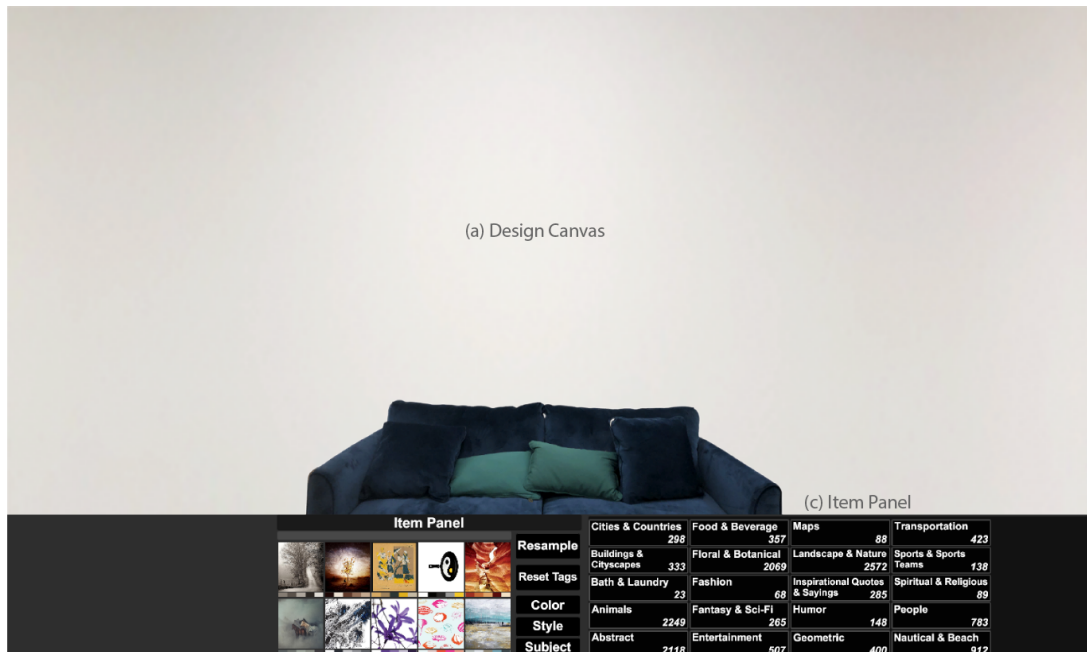
- **users\_group1.html**: the designs created by Group 1.
- **users\_group2.html**: the designs created by Group 2.

## 8 2D Interface

Figure 4 shows the 2D user interfaces of our tool used in the user evaluation. It consists of three components: a) the *Design Canvas* which shows in the background a photo of the wall and the room captured from the real world, based on which the user designs a gallery wall. The user can interactively modify the current gallery design on the canvas; b) the *Template Panel* where the user can select and apply a preset template for synthesizing an initial gallery wall design; and c) the *Item Panel* where the user can retrieve art items from the database by specifying different criteria.



(a) With template functionality



(b) Without template functionality

Figure 4: The 2D interfaces (a) with and (b) without the template functionality used in our user evaluation.

## 9 Example gallery wall designs

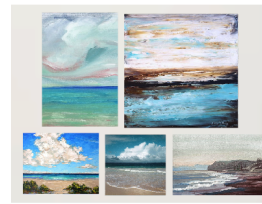


mixed reality



2D interface

(a) Participant A (Group 1)



mixed reality

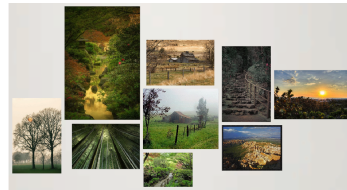


2D interface

(b) Participant B (Group 1)



2D interface



2D interface no template

(c) Participant C (Group 2)



2D interface



2D interface no template

(d) Participant D (Group 2)

Figure 5: Example gallery wall designs created by the user evaluation participants under different conditions.