# **Paint360**

**Testing Plan for Interactive Prototype 2**

### **Project Description**

The goal of this evaluation was to assess the second Paint360 prototype, which transitioned from a mouse and keyboard interface to an XR experience. The focus was to determine whether users could intuitively:

* Draw with finger-based painting gestures
* Erase using palm gestures
* Select and apply paint bucket tools through gesture then raycast

Success was defined by whether participants could learn these gestures quickly, complete drawing and erasing tasks with minimal guidance. Users would reflect positively on these changes and find them natural or intuitive after learning the controls.

Five participants from the class were asked to complete a series of short painting and erasing activities using the new XR gesture system. Data and insights were gathered through **time-on-task**, **observational notes**, and **post-test debrief quotes**.

## **Results**

### **Quantitative Outcomes**

* **Drawing task**: All five participants successfully produced a simple 3D sketch within a minute after initial instruction.
* **Erasing task**: Four participants completed the erasing task within the expected timeframe (~30–40 seconds), though two participants required multiple attempts due to palm angle misrecognition.
* **Tool switching**: On average, participants switched between paint and eraser tools in under 10 seconds once they understood the gesture mapping.

### **Qualitative Insights (with participant quotes)**

* **Finger painting immersion**: Users responded positively to finger-based drawing, noting the sense of immediacy and “embodied creativity.”
  + “It feels natural” (P3)
* **Palm erase limitations**: While the gesture was understood quickly, its angle sensitivity reduced efficiency.
  + *“If my palm tilts even a little, it doesn’t register.” (P1)*
* **Raycasting accuracy**: Several users mentioned that paint sometimes projected from the wrong finger joint.
  + “It looks like the paint is shooting out of my knuckle instead of the finger kind of weird.” (P5)
* **Overall enjoyment**: Participants reported high engagement and excitement about the shift to gesture-based input.
  + “Way more natural” (P1)

## **Analysis and Insights**

### **Strengths**

* **Intuitive learning curve**: Despite being first-time users, users quickly picked up the core gestures.
* **Increased immersion**: The embodied interactions through hand gestures significantly increased engagement compared to Prototype 1.
* **Positive effect**: Participants consistently described the experience as fun, natural and “futuristic.”

### **Weaknesses**

* **Gesture precision**: Raycasting alignment issues reduced accuracy and created slight disorientation.
* **Eraser sensitivity**: The palm erase function required very specific angles, breaking immersion during creative flow.
* **Limited feedback**: Users sometimes lacked confirmation about which gesture/tool was currently active.

## **Concept Iteration**

Findings from Prototype 2 strongly suggest that XR hand gestures are a promising foundation for Paint360. However, refinements are needed to ensure fluidity and reduce error states. Key proposed iterations include:

* **Finger-tip calibration**: Adjust raycast origin to match the fingertip more precisely, improving drawing accuracy.

“*Feels like holding a laser pointer of paint”* (P2)

*“It looks like the paint is shooting out of my knuckle instead of the finger kind of weird.”* (P5)

* **Eraser robustness**: Broaden the detection angles for palm gestures and introduce adjustable eraser brush sizes.

*“If my palm tilts even a little, it doesn’t register.”* (P1)

* **Gesture feedback**: Provide visual cues (highlighted fingertip when painting and glowing palm when erasing) to reinforce tool state and reduce uncertainty.
* **Tool flexibility**: Explore multi-finger gestures (e.g., two fingers for thicker strokes) and gestures for quick undo/redo to expand creative possibilities.

## **Reflection**

Prototype 2 was received well and showed clear progress toward the vision of an intuitive XR painting application. Transitioning from mouse-based controls to embodied hand gestures created a stronger sense of presence and creativity; validating the direction of the project. While limitations in gesture recognition such as raycast misalignment and palm-angle dependency occasionally disrupted the flow of art. These issues are primarily technical rather than conceptual.

What worked was the immediacy of finger drawing and the excitement participants expressed when interacting directly with virtual space. What did not work as well was the precision of erasing and the lack of feedback on active tools, which hindered learning and efficiency in more complex tasks. These challenges highlight the importance of calibration and multimodal feedback in sustaining immersion.

Overall, this iteration confirms that gesture-based XR interaction is a viable and engaging pathway for Paint360. The lessons learned here provide a strong foundation for refining the toolset, enhancing reliability and moving toward a fully immersive creative application.

### **Appendices**

## **Time on Task (seconds)**

| Task 1 (Draw Gesture) | 32 | 41 | 36 | 39 | 34 |
| --- | --- | --- | --- | --- | --- |
| Task 2  (Object Painting) | 15 | 12 | 18 | 10 | 14 |
| Task 3  (Colour Mixing & Preview) | 6 | 5 | 7 | 6 | 6 |
| Task 4  (Eraser) | 39 | 34 | 37 | 33 | 44 |

## **Think Aloud & Notes from Participants**

**Participant 1:**

* Picked up finger painting almost instantly: *“It feels like I’m sketching in the air way more natural than clicking a mouse.”*
* Slight frustration when paint raycast came from knuckle instead of fingertip.
* Found palm erase satisfying but noticed it only worked well when the hand was flat: *“If my palm tilts even a little, it doesn’t register.”*
* Suggested adding colour indicators on fingers when drawing to show which is active.

**Participant 2:**

* Took a few tries to align finger raycast but once calibrated found it intuitive.
* Commented: *“Feels like holding a laser pointer of paint, but I wish it stuck to the fingertip.”*
* Found palm erase fun but sometimes too slow. Recommended variable erase sizes.
* Enjoyed the colour slider gesture: *“Combining different fingers to change colours felt futuristic.”*

**Participant 3:**

* Enjoyed combining colours and bucket tool, described the experience as “*playful.*”
* Quoted: *“This is already more immersive than any art apps I’ve tried. It feels natural.”*
* Initially tried erasing at an angle and got no response, then adjusted the palm and succeeded.
* Suggested adding a visual glow around the fingertip when drawing to increase confidence.

**Participant 4:**

* Liked that each gesture was easy to learn after one demo: *“I didn’t need instructions twice it just made sense.”*
* Noticed erasing sometimes didn’t trigger properly, slowing task completion.
* Suggested a two-finger pinch gesture to thicken brush strokes.

**Participant 5:**

* Initially confused by tool state, accidentally drew while putting on the headset.
* Said: *“If I could see which tool was active on my hand, it would be better.”*
* When painting *“it looks like the paint is shooting out of my knuckle instead of the finger kind of weird.”*
* Found painting “*addictive*” and enjoyed drawing wildly.

## **Debrief Questions**

| **Participant** | **General Impressions – *“How did it feel to create art with only hand gestures? Was the experience enjoyable?”*** | **Specific Tools – *“Which gesture felt most natural? Which was confusing?”*** | **Workflow & Efficiency – *“Did switching between tools feel smooth? Any frustrations?”*** | **Suggestions – *“Any ideas for future development?”*** |
| --- | --- | --- | --- | --- |
| **P1** | “Really fun, felt like sketching in the air.” | “Drawing in the finger was natural, erasing worked but only if I kept my palm flat.” | “Mostly smooth, but I sometimes painted unintentionally because of my hand.” | “Colour indicators on fingers would help.” |
| **P2** | “Super enjoyable, felt futuristic.” | “The colour mixer using fingers was cool but a bit limited by the selection of colours, the ray coming from the wrong spot was confusing.” | “Switching was okay once I learned it, but erasing slowed me down.” | “Add different eraser sizes.” |
| **P3** | “Very engaging, I felt absorbed in it.” | “Finger painting was good, palm erase didn’t always pick up.” | “Smooth overall, though I hesitated when gestures didn’t register.” | “Glow effect on fingertip would show tool is active.” |
| **P4** | “Enjoyable and surprisingly easy to pick up.” | “Erase gesture needed exact angle.” | “Mostly seamless, only slowed by erasing traces.” | “Pinch two fingers to change brush thickness.” |
| **P5** | “It felt immersive, way better than a mouse.” | “The drawing gesture was great, but I got confused when I started drawing accidentally.” | “A bit clunky swapping tools at first, then fine.” | “Show active tool state on the hand UI.” |