## **Final Evaluation and Reflection – Paint360**

### **1. Objective and validation metrics**

The third interactive prototype of *Paint360* aimed to test the integration of new multimodal features including voice commands, passthrough mode toggling and improved gesture-based controls to evaluate how these combined inputs affect usability, expressiveness and immersion. The objective was to see whether adding voice and real-world context expanded user agency beyond what was achieved with gestures alone. The criteria being used to judge the success and effectiveness of this update will be a combination of time-on-task, think aloud & observational note taking and questions.

### **2. Results**

Quantitative and qualitative results were collected from user testing of the final Paint360 prototype. Participants performed three main gesture-based creative tasks and one system feedback task (HUD), while voice interaction could not be fully tested due to headset wifi connectivity issues.

#### **Time on Task**

| **Task** | **Description** | **Mean Completion Time (s)** |
| --- | --- | --- |
| **Task 1** | Draw Tool | 43.7 |
| **Task 2** | Erase Tool | 12.0 |
| **Task 3** | Voice Command | N/A |
| **Task 4** | Active Tool UI | 11.3 |

#### **General Impressions from Questions and Observations**

Overall, participants described the prototype as a *refined and more intuitive* version of the earlier builds.  
They highlighted smoother tool interactions and improved precision:

* The **crosshair and fingertip dots** gave clear visual feedback for where strokes would begin, reducing guesswork.
* The **eraser gesture** was perceived as significantly more natural and responsive.
* The **active tool HUD** was praised for reducing confusion, though users suggested that it could also appear pre-emptively (on selection) rather than reactively (after action).

Participants found the improvements to gesture detection and feedback meaningful, noting a clear sense of progression from earlier prototypes.

#### **Specific Tools**

* **Drawing Tool:** All users found the crosshair and fingertip points to be helpful for accuracy. Some suggested making its colour or opacity adjustable for better visibility against different backgrounds.
* **Eraser Tool:** Users confirmed that the new eraser worked *much more smoothly and quickly* than before, though accidental activation still occurred. They proposed adding a toggle mechanism to prevent unintentional erasing.
* **Active Tool UI:** The HUD successfully indicated which tool and colour were in use, improving overall workflow awareness. Participants appreciated the colour preview and immediate response but wanted a more proactive display that shows tool changes, not just tool usage.
* **Voice Commands:** Mixed responses. While the system could not be fully tested offline, participants suggested that *specific* commands like “Undo” and “Redo” would be genuinely useful if they could be integrated smoothly into active sessions.

#### **Workflow and Efficiency**

Although Passthrough Mode could not be evaluated due to voice command limitations, participants found tool switching fast and intuitive, noting that the current design supports an efficient, continuous creative flow. Feedback suggested that although potentially helpful in certain cases, voice commands are often not favourable over any other type of interaction mechanism. Furthermore, the active tool UI helped give users a larger awareness of their actions however was found to be too reactionary to be helpful in preventing workflow errors

### **4. Analysis and Evaluation**

#### **Multimodal Interaction**

The addition of voice input aimed to create a smoother workflow and allowed users to control global actions without interrupting the creative process. However, it also revealed dependence on environmental conditions, notably that voice commands don’t work unless the headset is able to connect to wifi sources other than the school network. We weren’t able to successfully connect to a personal hotspot and thus weren’t able to test this.

#### **Passthrough Integration**

The Passthrough Mode aimed to reframe the experience from a purely virtual activity to one grounded in mixed reality. Users may have a stronger sense of *presence* and *ownership* over their creations when painting in their real environment. Unfortunately as voice commands weren’t functional all opinions and suggestions were based on the idea of how passthrough would work. The majority of users and interviewees enjoyed the concept noting that it added a larger scale of uniqueness to artworks by being able to set up their own personalised backgrounds and settings to draw on.

#### **Gesture Refinement**

Improvements to the eraser and drawing gestures significantly reduced frustration. By broadening the palm detection radius and adding visual feedback, users felt more confident in performing gestures. The colour-mixing feature maintained high conceptual appeal but still challenged precision—especially when users combined more than two fingers.

### **5. Evaluation of Aims**

| **Aim** | **Outcome** |
| --- | --- |
| Enable intuitive control through gestures and voice | Achieved. Users navigated between tools and environments easily. |
| Expand creative expressiveness through real-world blending | Partially achieved. Passthrough was not successfully launched but users were onboard with the idea and gave early feedback. |
| Improve reliability and feedback from IP2 | Achieved. Eraser, HUD and drawing crosshair dots increased user confidence and minimized error rates switching between tools. |
| Support continuous creative flow | Achieved. Users remained engaged longer with minimal interruptions from bugs or errors. |

Overall, Prototype 3 validated the system’s multimodal direction, showing that combining hand-tracking with voice and environment blending can make digital art creation more accessible and immersive.

### **6. Reflection (Focus on IP2)**

#### **Prototype Session Review**

IP2 represented the biggest leap in Paint360’s development; marking the shift from a bare bones desktop controlled interface to a fully hand-tracked VR system. This transition replaced keyboard and mouse controls with embodied gesture input, allowing users to draw, erase and select colours directly through physical movement and gestures.   
Testing revealed that users quickly adapted to the gesture model and described it as more *natural* and *expressive* than the keyboard-and-mouse interaction used in IP1. Tasks such as drawing and erasing were completed more fluidly with participants reportedly feeling more connected to their artwork through direct hand motion.  
However, erasing gestures were inconsistent and sometimes unresponsive which disrupted workflow and reduced confidence. Participants also found it difficult to gauge when a tool was active, due to the absence of visual feedback. These limitations informed the priorities of IP3, which focused on clearer HUD feedback and smoother gesture detection for both drawing and erasing.

#### **Methodological Reflection**

The design process for IP2 followed a vertical prototype approach while testing combined observational notes with short, timed creative tasks to gauge the main feature set. This method proved effective for collecting both performance data (time on task & think aloud) and qualitative feedback on comfort and intuitiveness.  
The testing sessions were small-scale but frequent, enabling quick revisions between builds. Nonetheless, the methodology effectively generated actionable insights, particularly around gesture thresholds, hand tracking accuracy and visual feedback requirements. The breadth of data would have come from a specific set of user interview questions post prototype test. This was effective in that it allowed users to first experience, digest their thoughts and then give sound opinions or suggestions.   
In retrospect, more structured task variation and controlled environment building would have improved data consistency, as hand-tracking reliability fluctuated based on environmental conditions.

#### **Concept Evaluation**

Testing during IP2 and beyond confirmed that the project’s core concept; transforming Microsoft Paint into a spatial, embodied creative tool, was both achievable and meaningful. Paint360 validated the idea that gestural, body-based input enhances user immersion and artistic expression.  
Participants consistently described drawing in the 3D space as very immersive and rewarding not to mention much more fun rather than mechanical. This suggests a genuine shift from digital manipulation to embodied creation. However, IP2 also revealed key constraints of VR creativity namely physical fatigue from mid-air gestures, the absence of tactile feedback and limited precision for fine detailing. These factors indicated that while XR can enable expressive freedom it must also balance this with comfort and control mechanisms.

#### **Improvements and Extensions**

The findings from IP2 directly informed the iterations of IP3, which added visual feedback through an active UI, improved eraser detection and gesture and introduced voice commands for non-manual input. If further developed, the concept could benefit from integrating augmented reality features. Namely allowing artists to paint within their physical surroundings as background using Passthrough mode.  
Future extensions could also explore adaptive gesture calibration, allowing the system to learn individual hand movements to improve responsiveness. Integrating lightweight haptic feedback or a stylus interaction could further enhance precision and reduce fatigue.

**Appendices**

## **Time on Task**

* Task 1 (Draw Tool): 45 39 47
* Task 2 (Erase Tool): 13 12 11
* Task 3 (Voice Command): n/a headset couldn’t connect to wifi
* Task 4 (Active Tool UI): 11 13 10

## **Debrief Questions**

**General Impressions**

* How did you find the changes to the tools, did they make creation easier and were they intuitive?
* They were nice refinements to the original tools that helped with efficiency and accuracy
* I liked that there was a crosshair dot for drawing, this made precise strokes really easy
* I think the tools were nicer to use than previously, especially the eraser was much more natural however I’m not sure about always leaving it on

**Specific Tools**

* Was the crosshair on the drawing tool helpful for preciseness?
* Yes i found it nice to be able to see exactly where the drawing will start from
* It was really intuitive to see the dots on the fingers and also the midpoint from where the drawing begins
* I think so, however maybe you could change the colour so that its not yellow or not filled out with colour and only a border
* Is the eraser tool working more smoothly now than before?
* Yes the eraser is much better
* The eraser is much quicker but sometimes accidental activation made me had to redraw some parts
* The erase gesture is much more natural however it may need to have a toggle on and off instead of always being able to be triggered in case of accidental movements
* How did you find the active tool UI? Did it help reduce confusion or mistakes?
* I liked the feedback that it gave but noticed it was only reactionary as in after I did actions or used tools
* It would be nice if the active tool UI would show when you select a tool, this may need to mean that toggles for active and inactive are introduced instead of having holding gestures
* I liked how quickly it is able to update and how it has a preview for colour as well
* Did you find the voice commands useful or would you prefer to have these functions on a menu?
* 50/50 I struggle to find voice commands to be very helpful for most tasks and interactions however there are some specific cases such as redo and undo that might benefit user work flow if they are able to be seamlessly called during artwork

**Workflow & Efficiency**

* Did switching between scene and passthrough mode work well?
* N/A voice commands weren't able to be turned on on the headset