

# GROUP ASSESSMENT ITEM COVER SHEET

Student Numbers:	Emails:	FIRST NAMES	FAMILY / LAST NAMES
3 2 3 7 6 9 3	c3237693@uon.edu.au	Thomas	Smith
3 0 8 8 8 1 0	c308810@uon.edu.au	Tamara	Wold
3 2 7 3 5 2 8	c3273528@uon.edu.au	Noor Ul Hasnain Bokhari	Sved
3 1 8 7 6 5 4	c3187654@uon.edu.au	James	Rossington

Course Code

S E N G 2 2 6 0

Course Title

Human-Computer Interaction

(Example)

A B C D 1 2 3 4

(Example)

Intro to University

Campus of Study: Callaghan (eg Callaghan, Ourimbah, Port Macquarie)

Assessment Item Title: Assignment 2 Due Date/Time: EOD 8.11.19

Tutorial Group (If applicable): Word Count (If applicable):

Lecturer/Tutor Name: Shamus Smith

Extension Granted: ☐ Yes ☒ No Granted Until:

Please attach a copy of your extension approval

NB: STUDENTS MAY EXPECT THAT THIS ASSIGNMENT WILL BE RETURNED WITHIN 3 WEEKS OF THE DUE DATE OF SUBMISSION

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## **Team Tuesday SENG2260 High Fidelity Prototype**

James Rossington - 3187654

Thomas Smith - 3237693

Noor Ul Hasnain Bokhari Syed - 3273528

Tamara Wold - 3088810

University of Newcastle

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## **Abstract**

This report will attempt to outline the design, implementation and formative evaluation of our prototype interface for use on the Microsoft™ HoloLens 2 augmented reality system. The purpose of our prototype is to create a unique user experience in the UON gallery, that will provide users with an enjoyable, free form virtual guide into the many art pieces available.

## **Problem Domain**

This interface prototype is intended to be used in the UON art gallery in order to facilitate Virtual tours within the gallery by using the Microsoft™ HoloLens 2. As the UON art gallery is located within a University campus, the UI is targeted mainly at UON students and staff (age > 17).

Art galleries are a place where people of all ages and backgrounds can come together and appreciate the works presented to them. Traditionally, art galleries are a look only, don't touch environment. The Leonardo Di Assistant was created with this in mind and attempts to cater for people from all walks of life, while creating an immersive experience that navigates away from the look only standard. Users can manipulate the gallery around them to suit the experience they wish to have.

The assistant has a simple interface which allows for ease of use. While the target group is mainly UON students and staff, as this is where the gallery is located, the interface can be effectively used by anyone, including children and the technologically uninclined.

Our aim is to ensure that all users have an enjoyable experience while in the art gallery and to have that experience further enhanced by the use of the Leonardo Di Assistant.

## **Design**

The idea behind the chosen final design of the Leonardo Di Assistant is to provide our target group with a simple yet effective way to have an immersive experience in the UON art gallery. This was achieved by providing users with features that can be found in other areas of life such as the widely used symbols used and gestures that they might use if the hologrammed objects were physical objects.

From our original prototype and user testing, we discovered a number of key, high-risk areas in the interface. It was found that users were not accustomed to selecting a color and then tapping

the artwork to apply the color. For the final design we decided to have the artwork change color in sync with a user selecting a color, cutting out the need to also tap on the artwork (see Figure 1).



*Figure 1: Comparison between low and high fidelity scenario 1*

There was also the issue of users not being able to distinguish between what was part of the background and what was able to be interacted with. We decided to implement a virtual light shimmer on objects that were interactable (see Figure 2). This effect is widely used in video games, which we assume the majority of our target group have engaged in, and therefore will be easily recognized.



*Figure 2: Example of information icon glimmer*

Gestures and voice commands proved to be a matter of concern during both prototype tests. Although we had information about both in the info menu, we found this to be of little to no help to the users (see Figure 3). We found that the gestures employed by the HoloLens 2 did not come naturally to most users. Information points are provided to help users navigate the gestures needed to interact with the interface, however as a future measure, we would either try and

engage Microsoft to update their gestures, or we would provide our users with custom gestures that would impersonate real life better.



*Figure 3: Information icon in low fidelity prototype*

Voice commands were severely underutilized during our low-fidelity user testing due to that fact that they either didn't know that voice commands were available, or which voice commands to use. For the hi-fidelity prototype we added in a pinging noise, similar to Apple's Siri, which when tested showed that most users were able to respond positively to the noise and understand that they could now use a voice command. There was still the problem where the users were unsure of what voice commands were able to be used. For the final design we included a list in the info menu which showed all the basic voice commands that could be used.

For the low-fidelity prototype we hadn't focused on the font and color for the words and symbols used as it wasn't immediately apparent it needed attention with only using paper and cardboard. When we however moved on to the hi-fidelity prototype, the need to choose these two aspects correctly became more obvious. We chose Helvetica for the font as this is a standard font used in design projects. For the colors, we chose white with a cyan highlight as this stood out against the mainly brown background of the art gallery (see Figure 4).



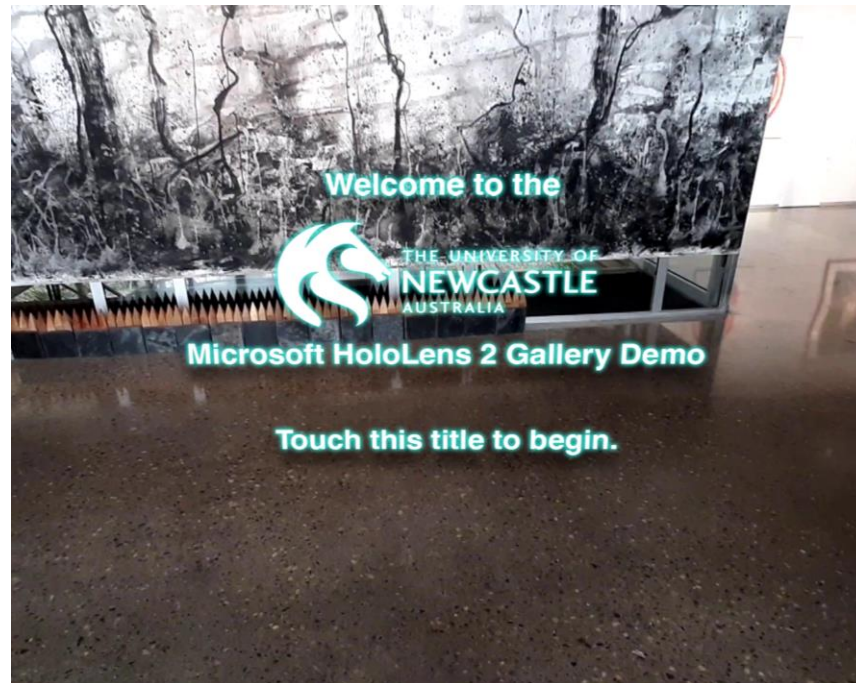


Figure 4: Example of text and color usage in interface design

## Implementation/Prototype

The virtual interface demonstrated in the presentation was created with the help of several image and video manipulation applications. Adobe Photoshop was used to create all icon and user interface resources, as well as enabling the transparency effects used later in this work pipeline (images were saved as .pngs). These image resources were then imported into Adobe After Effects for further positioning, animation and rendering. During this stage, the UI animations were first created with a static background to simulate the intended output. This made it easier to overlay the User Interface onto real life footage of the gallery (obtained via phone video camera). The final step to creating the presentation was to render the 3D animation and then compress the footage for embedding into the PowerPoint slideshow, Sony Vegas Pro 15 was used to import the After Effects rendered video files (.avi, and large!), and convert to a much more manageable .mp4 format.

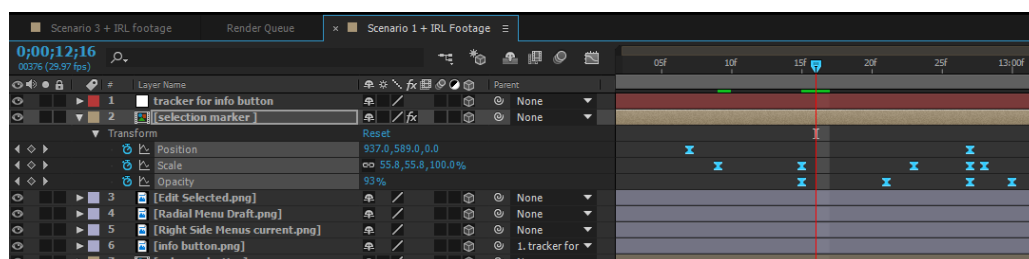


Figure 5: The Adobe After Effects Interface for the 3D animation sequence



Figure 6: Applications Used.

As the initial prototype consisted of our conceptual designs printed onto cardboard and presented to our user/testers by hand, the transition to a digital prototype to be used in the presentation required decisions regarding implementing the original design objectives and UI features, as well as working to improve the prototype as a direct result of user feedback.

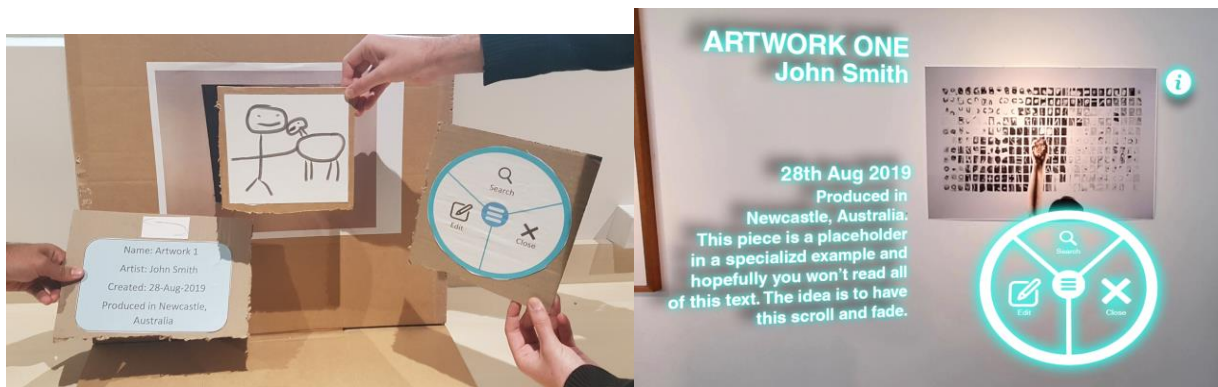


Figure 7: Differences between the low and high fidelity interfaces (scenario 3 comparison).

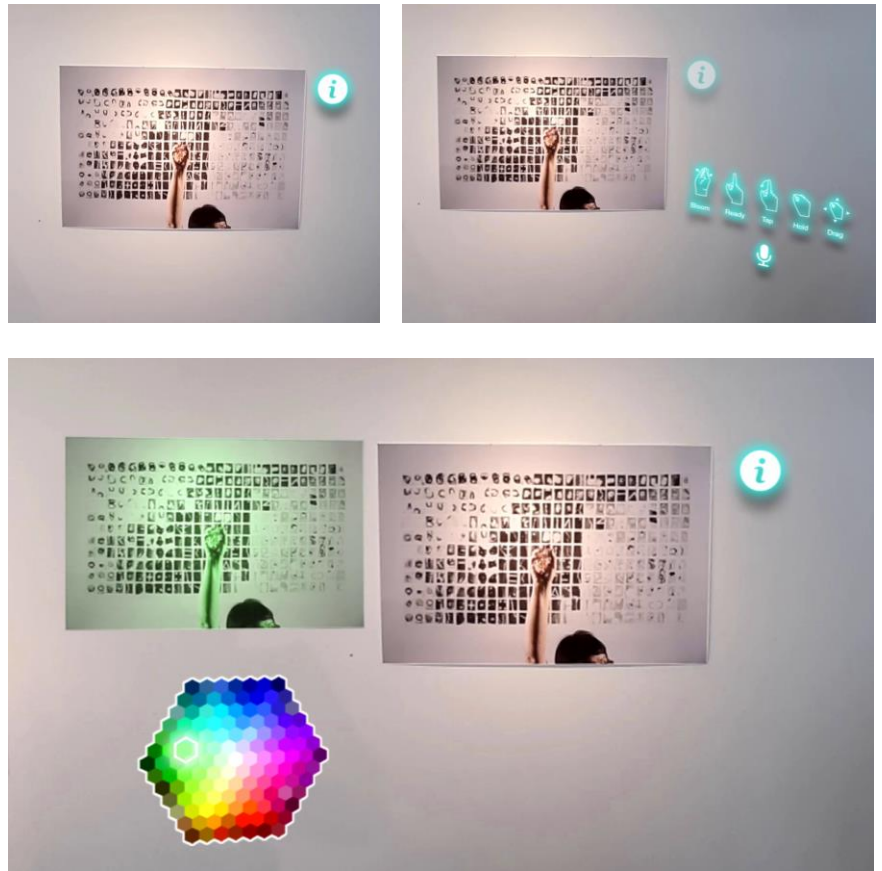
As the presentation allowed us to visually simulate our user interface scenarios with a ‘scripted’ demo, the decision to develop a 3D animation allowed us to achieve both this and implicate a working ‘augmented reality’ with the use of real life footage included.

The following scenario descriptions detail the interface implementations scenarios created to demonstrate the functionality of the prototype. Various issues and risks that may arise during actual interaction with a product version of the interface were not considered for the presentation’s build, as the purpose to demonstrate the interface’s features was the intent. However, in the following sections we will detail the correct scenario procedures as possible areas of concern.



### Scenario 1 - Changing color of a painting.

The first scenario to be demonstrated is the user goal and use case of changing the colour, hue or saturation of a desired gallery item, to more easily distinguish or ‘view’ the painting. This feature assists the colourblind or visually impaired, as well as potentially revealing painting details under different lighting, colouration. The gesture overview in the top right image presents the user with several gestures that are possible to use in the current scenario.



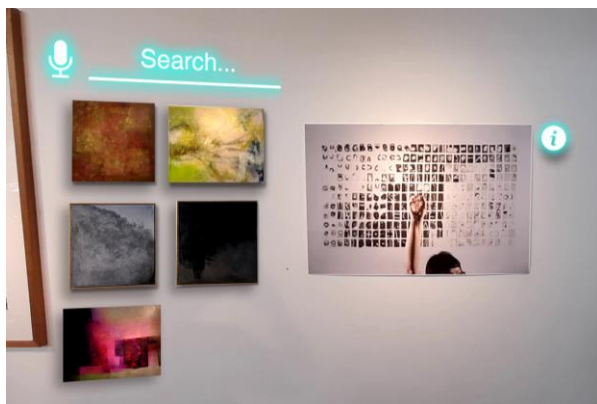
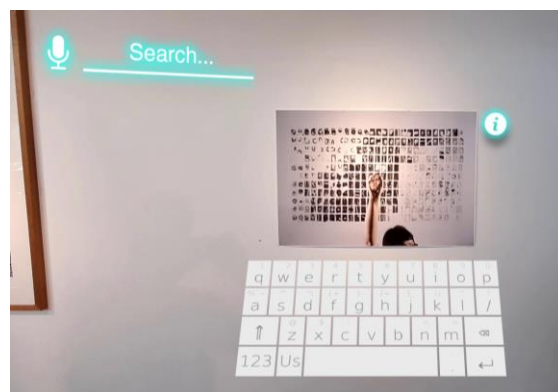
### Scenario 2 - Rotating a sculpture.

The second scenario interaction involves selecting and rotating a 3D object in the gallery, without interfering with the original sculpture or item. The user follows familiar gestures to the previous scenario as they ‘tap’ to select, and then proceed to using the pictured ‘hold’ gesture (gesture overview in past scenario) to rotate the 3D object in real-time.



### Scenario 3 - Searching related paintings.

The third and final scenario to be presented involves the viewing of a painting, the user input interaction of searching for a painting, as well as the navigational features of the interface to assist in finding the desired related gallery item. This scenario also showcases our 'radial quick menu' which is presented to the user upon initial 'tap' selection of a gallery item (previous scenario tasks included this functionality, however it is demonstrated in more detail here). As the user inputs their desired painting into the interactive virtual keyboard - or simply decides to find a related painting - they will be directed by subtle inobtrusive 'footprints' on the ground to their destination.



## Evaluation

The way in which user testing was conducted did not differ heavily from that of the low fidelity prototype user testing. Instead of using cardboard and paper to emulate the UI, we created a functional UI using the HoloLens 2 Emulator provided by Microsoft™ (<https://docs.microsoft.com/en-us/windows/mixed-reality/using-the-hololens-emulator>).

The target users for this prototype were University students and staff (age > 17). The test users were selected from SENG2260 and therefore they lay within our target user group.

We conducted high fidelity user testing using the following structure:

1. We briefed the user (see Appendix A) to provide an overview of our intentions in having them test our high fidelity prototype.
2. The tasks were presented, starting with scenario 1, with the tester informing the user to openly present questions and provide any comments as they wish when performing the tasks.
3. As the user was completing the scenario, we made observations based on their performance and how they went about using our interface.
4. After the user completed all three scenarios, we asked the user to complete a questionnaire (see Appendix B).

### Scenario 1

#### Change color of painting

	Time Taken (s)	Times user asked for help	User comments
User 1	35	1	"I wasn't sure if I had to save the color change"
User 2	45	0	N/A
User 3	30	0	"How can I see the artwork information?"

Our high fidelity iteration of scenario 1 saw a tighter correlation between our users during user testing and provided us with some interesting points to discuss. First, we observed that users had a tendency to interact with our information button next to the artwork, expecting to see the

artwork information. Also, one of our users was looking to somehow save the color change to the artwork. This was not an intended feature in our design, since users won't be keeping any progress, however, it could be an interesting iterative addition to have progress 'soft save' and have the altered artwork recess into the background to be compared with another edit by the user.

The time taken for this scenario was reduced by 74.9 seconds on average (high-fidelity average is 36.6 seconds) from the low-fidelity stage. We believe multiple factors played into this result. First and foremost, using an emulator for user testing the high-fidelity prototype made the experience smoother, since the screen changes were automatic rather than relying on a definitive tester to change the screens. Furthermore, we believe due to the nature of our user group, and their experiences with user testing low-fidelity prototypes previously, experience bias played a significant factor (although this group did not test our low-fidelity prototype).

## Scenario 2

### Rotating a selected sculpture

	Time Taken (s)	Times user asked for help	User comments
User 1	10	0	N/A
User 2	15	1	" Did not know which gesture to use"
User 3	8	1	" Gestures are confusing "

The general trend in Scenario 2 in low-fidelity and high-fidelity prototype user testing is that most users found it easier to accomplish scenario 2, as shown by the time taken in comparison with other scenarios. The only major problem that we saw in both prototypes is that some users got confused by which gestures to use to rotate/move the sculpture. This problem could have been solved by using a different gesture for the specified action, but as the prototype was based on the HoloLens 2 interface, we kept the built-in gestures. This problem was somewhat rectified by using an information panel that glowed when a user selected a sculpture. This information panel showed how to perform the gestures for each action.

## Scenario 3

### Search for paintings by the same artist

	Time Taken (s)	Times user asked for help	User comments
User 1	15	0	N/A
User 2	23	0	“ Straight Forward”
User 3	17	0	“ N/A“

In scenario 3, we saw a significant drop in the time taken by users to accomplish the task as compared to the low-fidelity prototype. All of the users found it easy to navigate around the UI and search for more paintings by the same artist. The only drawback we found was some parts of the UI were a bit slow to load which can be attributed to the lack of a fully functional HoloLens 2 in order to showcase the UI.

## Data Review

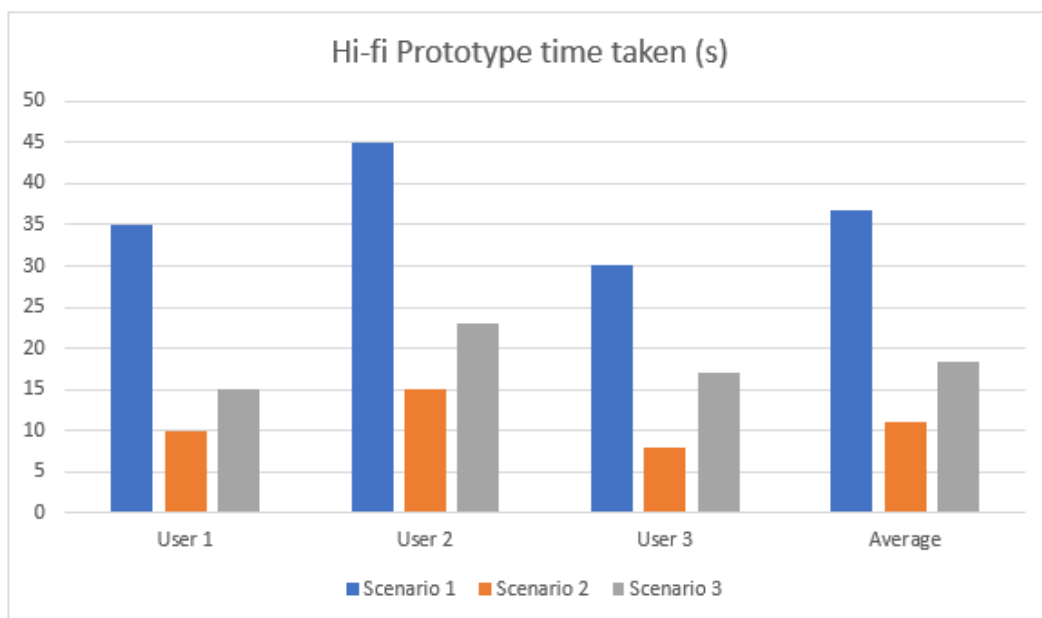


Figure 8: Graphical representation of time taken to complete scenario tasks in high fidelity user testing

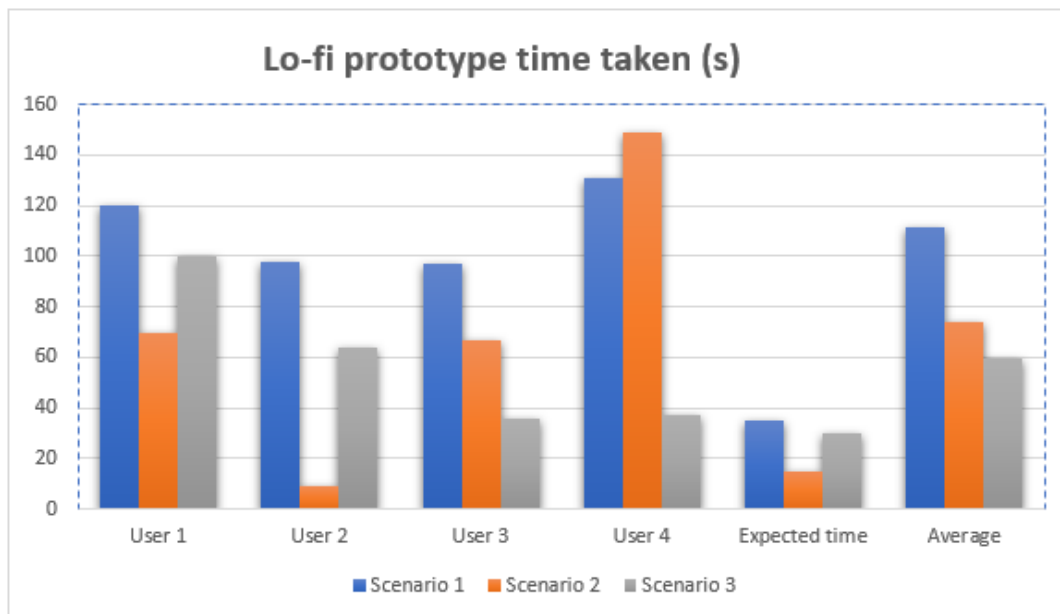


Figure 9: Graphical representation of time taken to complete scenario tasks in low fidelity user testing

The results from the questionnaires were as follows (see Appendix B for questionnaire):

Question 1: 7, 6, 6 with an average of 6.33 out of 10.

Question 2: 8,9,8 with an average of 8.33 out of 10.

Question 3: 7,8,7 with an average of 7.33 out of 10.

### Overall trend

As seen in figures 8 and 9 above, moving from a low fidelity prototype to a high-fidelity prototype has reduced the time taken to complete our scenario tasks by 67% for scenario 1, 82% for scenario 2 and 69% for scenario 3. We suspect there are a few non iterative design influences in this outcome. First, we believe that experience bias plays a major role in the reduced time. Our user group has quite a lot of experience in understanding user interface design, since they are attempting to design their own interface, and could have possibly even been using the HoloLens 2 Emulator for their own interface design. With this, they would not need to acclimate to the function of the emulator. Additionally, the ability of our users to quickly navigate through our



interface, compared to low fidelity user testing, can be attributed to the more fluid nature of using an emulator in high fidelity user testing.

## Usability Problems

Problems that arose in the user testing of our high-fidelity prototype were as follows:

- Confusing information button next to artworks that users expected to be artwork information, rather than gesture information.
- Users had issues with gesture choice for rotating the virtual sculpture in scenario 2
- User expected to be able to save color change of artwork in scenario 1.
- Readability of text

## Solutions

Possible solutions to these usability issues include moving the information icon to another location on the UI and implementing a more appropriate icon near the artwork that is representative of its function. Also, we can implement an ability for color changed artworks to recess into the background of the UI for use by the user to compare any further alterations they would like to make in the edit function.

The results of the questionnaire indicate that we should focus on attempting to improve the readability of our interface in terms of text font, size and color. Furthermore, we should attempt to develop a more consistent approach to the development of our navigation tools to allow users a more simplistic experience when moving between virtual overlays.

A solution for gestures, as stated above in this report, could be to approach Microsoft about implementing custom gestures for users or fine tuning their current gestures.

## Review

Although we believe there are factors outside of our design choices that have influenced the large reduction in time taken, some of our design choices have also been an influence. For scenario 1, we altered how the color change to the artwork is applied, rather than having the user select the color and then select the painting to apply it, we had the artwork change color as the user hovered over colors in the palette. This reduced the number of steps required for the user to complete scenario 1, therefore reducing the overall time taken by each user. Scenario 2 consisted of users essentially trying the different hand gestures before eventually discovering they needed to use the pinch gesture to actively grab the virtual object. For scenario 3, users had no issues

with navigating to the search page, mostly due to the fact they saw the menu in scenario 1, and simply typed in anything to complete the scenario.

With this, our high-fidelity user testing has produced significant results in terms of how our interface could be further iterated to be more compliant with user needs. The subsequent evaluation of usability issues has paved the way for possible solutions, backed up by the results produced from our user testing.

## **Reflection**

This project has provided insight for all team members into the challenges and scope that designing an interface for an augmented reality system requires.

## **Prototyping**

Iterative design process is the simple concept of prototyping, testing, analyzing, and refining a product or process. Applying this to our project allowed us to see why it is important to use a process like this in order to deliver a product that a user finds easy to use.

In order to design our prototype effectively we used multiple prototyping techniques which included the use of paper sketches, storyboards, and mock user testing in order to identify problems successfully. As a group we found mock user testing especially effective before the actual user testing as it allowed us to set a benchmark for each scenario which in turn helped us to compare how well the prototype was working in the actual user testing. The use of storyboards and paper sketches helped us iron out design issues before building the low-fidelity prototype.

## **Risk**

During the development of our prototype we found effective risk assessment allowed us to premeditate some of the issue's users would face and in turn influenced some of our design decisions in order to mitigate those issues. One of the things we would change is when to conduct the risk assessment, most of our risk assessment was done after the building the prototype which meant that if we wanted to change some parts of the UI for risk mitigation, we had to make significant design changes. In conclusion conducting the risk assessment before building the actual prototype would have saved us a significant amount of time and effort which could have been used to further improve the prototype.

## Evaluation

During user testing we used different methods of evaluation including user feedback and group member observations. The low fidelity prototype was significantly revamped after the user testing, which showed that our personal bias might have caused us to overlook some basic functionality issues within the UI, taking voice controls as an example most users did not use this function and many user reported in the feedback that they simply did not know if it existed. We rectified this by adding a sound that would mimic that of Apple's Siri assistant. This change led to a significant improvement with multiple users using it during the hi-fidelity prototype. This showed that people usually respond/act if they are exposed to a familiar stimulus, in this case an auditory stimulus.

Another observation that we saw, which was surprising, was that the users had a much easier time navigating a real-world application (hi fidelity prototype) rather than one based on paper or cardboard (low fidelity prototype). This showed that when users are exposed to a familiar system that they might have been exposed to before it will lead to much better results.

In conclusion, a system, application, UI can be designed in a more complex manner as higher adoption of tech by users makes comprehension of new technologies easier.

## Next Steps

The next steps to take in developing our user interface is to iterate the interface on a functioning Microsoft™ HoloLens 2, utilizing all of the discoveries obtained in both the low and high-fidelity prototypes. Building the interface on a HoloLens 2 would provide an avenue for discovering any more issues for the user through another user test, possibly internally at Microsoft.

## References

Microsoft HoloLens 2 Emulator <https://docs.microsoft.com/en-us/windows/mixed-reality/using-the-hololens-emulator>

Microsoft mixed reality gestures  
<https://docs.microsoft.com/en-us/windows/mixed-reality/gestures>

## Meeting Minutes

### Meeting Sat 5/10/19

**Total Time:** 1 hour 30 minutes

**Summary:** Meeting to discuss plan of action for starting high fidelity design.

**Present:**

Noor  
Tamara  
Thomas

**Absent:**

James

**Action List:**

Organizing presentation deliverables and flow.

Starting discussion on report deliverables with emphasis on problem domain and design.

Confirming interface scenarios.

**Before next meeting**

**Tamara:**

Problem domain - not completed

**Thomas:**

Start presentation slides - completed

**Noor:**

Find the best way to create an interface for user testing. - completed

**James:**

Starting video walkthrough of interface based on scenarios for presentation. - completed

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## Meeting Tue 8/10/19

**Total Time:** 2 hours

**Summary:** Discuss presentation speeches and splitting up talking points.

**Present:**

Noor  
Tamara  
Thomas  
James

**Absent:**

**Action List:**

Split talking points for presentation.

Finalize interface design for high-fidelity user testing.

**Before next meeting**

**Tamara:**

Finish problem domain in report - completed

**Thomas:**

Write up introductory script for presentation - completed

**Noor:**

Work on emulating interface for user testing - completed

**James:**

Continue making video for presentation to show scenarios - completed

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## Meeting Tue 15/10/19

**Total Time:** 1 hour

**Summary:** Finalize user testing materials.

**Present:**

Noor  
Tamara  
Thomas  
James

**Absent:**

**Action List:**

Finish and finalize emulator for user testing, observation sheets and briefing scenarios.

---

## Meeting Wed 16/10/19

**Total Time:** 1 hour

**Summary:** User Testing.

**Present:**

Noor  
Tamara  
Thomas  
James

**Absent:**

**Action List:**

Conduct user testing.

### **Before next meeting**

**Tamara:**

Write up script for user testing section (presentation) - completed

**Thomas:**

Write up script for conclusion (presentation) - completed

**Noor:**

Write up script for primary risks and user testing (presentation) - completed

**James:**

Continue working on scenario videos for presentation. - completed

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## **Meeting Sat 26/10/19**

**Total Time:** 2 hours

**Summary:** Finalize presentation.

**Present:**

Noor  
Tamara  
Thomas  
James

**Absent:**

### **Action List:**

Put together individual scripts and alter to make presentation flow well.

Finalize presentation slides.

Practice runs.

### **Before next meeting**

**Tamara:**

Practice for presentation - completed

**Thomas:**

Practice for presentation - completed

**Noor:**

Practice for presentation - completed



**James:**

Finish presentation videos and practice - completed

---

## **Meeting Thurs 31/10/19**

**Total Time:** 2 hours

**Summary:** Final presentation run-through and present

**Present:**

Noor  
Tamara  
Thomas  
James

**Absent:**

**Action List:**

Last presentation practice.  
Present in-class.

**Additional Comments:**

Our group dynamic was great throughout the whole assignment with no problems.

We continued to discuss over Discord, constantly communicating and exchanging points of interest for the final report.

## **Appendix A**

### **Briefing**

Today you'll be testing our high-fidelity prototype interface intended for use with augmented reality systems, specifically the Microsoft HoloLens 2.

You will be soon be presented with several scenarios designed to represent typical situations expected when using augmented reality. We ask that you attempt to use the laptop in front of you, featuring an emulated interface, where you can utilize the touchpad to interact.

These tests will allow our team to gauge and anticipate features needed to improve further iterations and prototypes. There are no wrong answers and we value all feedback.

The features and implementations in this build are not a clear indicator of the final product as many design choices are subject to change. Improvements and alterations to the design of our systems may be a direct result of your feedback and constructive criticisms.

Thank you for assisting us today.

## **Appendix B**

### **Questionnaire**

You may answer any of the following questions at your discretion.

- 1.** Please select a number ranging from 1 to 10, with 1 indicating unclear and 10 indicating extremely clear, how would you rate the readability of text and icons of the interface?
- 2.** Please select a number ranging from 1 to 10, with 1 indicating very difficult and 10 indicating very simple, how would you rate the ability to navigate through the interface elements?
- 3.** Please select a number from 1 to 10, with 1 indicating you wouldn't use it and 10 indicating you would certainly use it, how would you rate the likelihood of you using this interface if it was available to you in a real art gallery?

## Appendix C



### A LITTLE BIT ABOUT OUR PROTOTYPE

- Aim to diversify our interface for use by all types of visitors to the UON gallery
- Allow users to interact with what they came to see, the Art
- An interface designed for ease of use by users with extensive technological skill AND those who just want to try out something new while they experience the UON Gallery
- All using the power and creativity of the state-of-the-art Microsoft HoloLens 2



Image Source: <https://www.microsoft.com/en-us/hololens/apps>

The image shows a man with a beard wearing a Microsoft HoloLens 2 headset. He is holding a 3D model of a mechanical component, which appears to be a motor or a pump. The model is rendered in a metallic, copper-like color. In the background, there are floating digital overlays, including a line graph and a circular gauge, suggesting a data visualization interface. The overall scene is set against a dark, textured background.

## SCENARIO 1

**Scenario 1:  
Changing colour of painting**

## SCENARIO 2

**Scenario 2:  
Rotating an object**

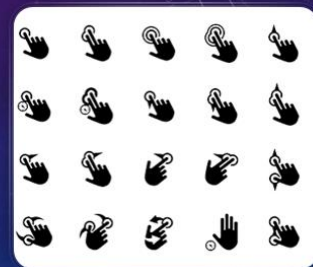
## SCENARIO 3

### Scenario 3: Searching for similar paintings

## OUR RISKS

Our primary risks include:

- UI Layout/Design
- Gesture Controls
- Voice Controls



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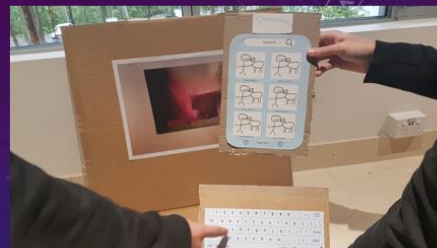
## USER TESTING

- We attempted to reduce the risk of some of the elements of our interface through iteration
- We attempted 4 Low-Fidelity iterations and 2 High-Fidelity iterations
- We chose to not overhaul our current scenarios
- We found the medium that user testing was conducted with had an impact on the users experience. This was a surprising result.

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## USER TESTING 2

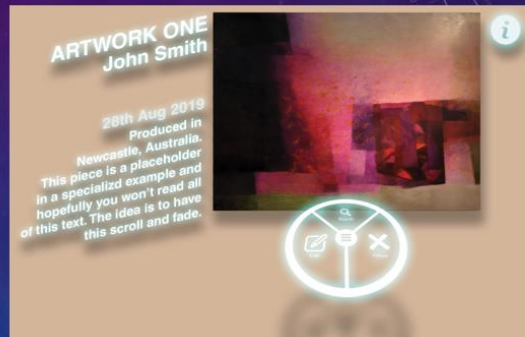
- In the low-fidelity stage, user testing came in the form of a physical, predominantly cardboard and paper concept.
- For the high-fidelity stage, we implemented a functioning emulated interface but continued to focus on our original scenarios.





## APPLICABLE HEURISTICS

- Built-in gestures of the HoloLens 2 allow users to directly interact with interface objects
- WIMP used for ease of navigation through virtual overlays and screens
- Clear and readable fonts and colours



## APPLICABLE HEURISTICS 2

- Issues that arose in our previous prototype and during user testing, allowed us to identify important heuristic issues.
- One example was the colour picker from the first scenario.



## SOME KEY POINTS

- Interface design is intuitive, with motivation to allow users to directly interact with what they have come to see, based on our scenarios.
- How conducting user testing allowed us to choose our path for iteration
- Iteration was done to control risks, reducing the probability of user confusion or interface design failure.
- What heuristics were implemented in our design to allow all types of users to have freedom when using our interface.

Thank you for listening!



