GROUP ASSESSMENT ITEM COVER SHEET

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Course Code	Course Title
S E N G 2 2 6 0	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: High Fidelity Prototype

Due Date/Time: 29/10/21

Tutorial Group (If applicable): Wednesday 3-5pm Word Count (If applicable):

Lecturer/Tutor Name:

Extension Granted: ☐ Yes ☒ No Granted Until:

Please attach a copy of your extension approval

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Signature: Jeremy Corling Date: 29-10-21

Signature: Harlan De Jong Date: 29-10-21

Signature: Matthew Faul Date: 29-10-21

Signature: Bryce Dowie Date: 29-10-21

Signature: Anton Lyamin Date: 29-10-21

DATE STAMP HERE

Final Project Report

SENG2260/SENG6260 – Human-Computer Interaction
Assignment 2

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Introduction

Our team has been tasked with prototyping an interface that would enhance activities within an art gallery setting. The interface should make use of the features that augmented reality devices, such as the Microsoft Hololens, offer. Our team has chosen to create an application and interface for the use of tour guides. After extensive workshopping we came up with three scenarios to test our prototype with. These include:

1. Starting and running a tour on a schedule
2. Reporting an individual that may pose a threat.
3. A tour guide answering questions posed by the tour group

The contents of this report will cover the process the team has followed to go from a low-fidelity to a hi-fidelity prototype.

Problem Domain

The problem domain represents the core functions of a system under study. It is the area of expertise we are looking to solve a problem in. To create a well rounded human-computer interface, it is imperative that we have a good understanding of the environment it will exist in as well as the tasks, behaviours and responsibilities of the people part of it. To properly grasp the problem domain for our application, our team employed the empathy step from the design thinking process. Understanding and empathising with a person's motivations and frustrations in their role improves our willingness to consider their needs when designing a product. In practice this meant conducting research about the Tour guide profession and the experiences of those within it. The information found was brought to a group discussion, where a user persona was assembled. User personas are a common technique used in gathering and personifying aspects of the problem domain. It was vital to create an fleshed out, engaging persona that was easily memorable and referred to at different stages of the design process. In figure 1 below you will find Jenny, a gallery tour guide which embodies our applications problem domain.

<table>
<tr>
<td rowspan="2"> 
Jenny</td>
<td rowspan="2">Tasks

To conduct tours to 100% completion in the given time

To keep the visitors comfortable and safe on premises

To answer as many questions as they can during a tour

To stay up to date with any need exhibits and accompanying tours</td>
<td>Goals

To keep visitors interested and enthusiastic

To improve as a tour guide

To answer any questions to a high quality

To feel confident and calm when conducting tours</td>
<td rowspan="2">Frustrations

Answering questions as their asked often disrupts her from conducting the tour

Recent terrorist attacks at tourist destinations in Russia and Egypt has left her worried about the safety of those in the gallery

Reporting suspicious individuals has meant walking up to security and pointing out the individual, or using a noisy walky talky

Determining her progress through a tour can be painstaking if she forgets the start time or how many tour stops are left ahead of her

Forgetting locations of particular exhibits or facilities can lead to awkward situations with curious visitors</td>
</tr>
<tr>
<td>Bio

Age: 27
Occupation: Tour guide
Location: newcastle
Archetypes: book-worm, perfectionist</td>
<td>Motivations
Enthusiastic visitors which appreciate her work

A consistent record of good performance

Exposure to different art and parts of history</td>
</tr>
</table>

Figure 1: User Person Expressing The Problem Domain

Researching tour guides, we found that the key issues they faced were consistent performance and performance standards, visitor satisfaction and on-site safety (kafy, 2020). These issues lie in our problem domain and are central in the design of our AR application. Our design's aim is to keep tour guides feeling confident, calm and safe in their day to day work, so they can focus on providing great experiences to the gallery's visitors.

Design

The final design was based heavily on the user feedback from the evaluation of the low fidelity prototype in assignment 1. Reflections on our initial design model and user feedback lead to the establishment of a core set of design concepts carried through to the hi-fidelity prototype.

Tour HUD

User comments from the low-fidelity prototypes evaluation made it clear that the hud design needed a rework. Our intentions to make time management and gaging progress easier did not translate well. As seen in figure 2, the design was spaced out and visually cluttered. Our team decided to go with one user's suggestion of having the HUD resemble a video player. After Some consideration the youtube player and its “chapter” feature were employed as the motivation for our new design. This new design is compact, clearer in its intent and easier to follow. The tour is separated into several bars or chapters, one for each stop. As time progresses so does the player time bar, eventually filling the entire chapter. Selecting a bar provides more information about each stop. The user can use visual indicators or the timer itself to gage their timing. Similarly they can count the number of unfilled bars to gage their overall progress. The color of the bar (green, yellow or red) indicates how on time the tour guide is within that particular stop of the tour. More of the hud design, especially its use of color can be seen in figures 8 and 10.

Figure 2: Old, Low Fidelity Hud Design

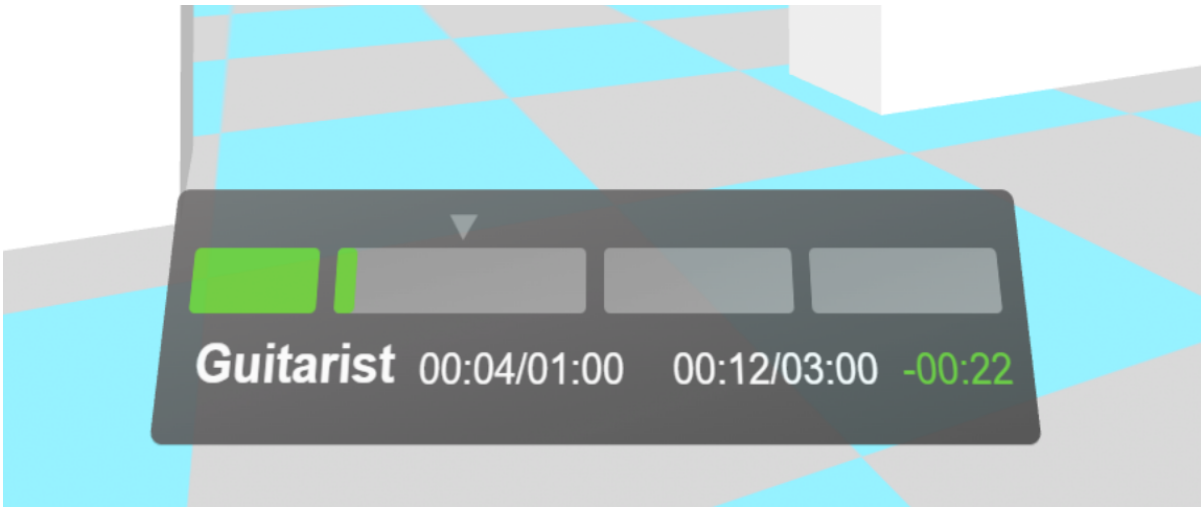


Figure 3: New, High Fidelity Hud Design

Utilization of AR technology in a 3d environment

Another constructive criticism offered in the past, was the lack of interaction with the environment, coupled with a clunky stop changing process when conducting a tour. The previous mechanism had the user open the context menu and select the “next stop” button (figure 4) . Once reaching the final stop it was also unclear that the user had to once again select the button to stop the tour timer. This led to an awkward and frustrating experience when conducting a tour. For the next iteration of the design, our team decided to make use of the AR capabilities in a 3D environment and make the stop changing mechanism more natural and intuitive. Virtual plinths (figure 5) were put at the location of each stop on the tour, this way the tour guide would get a visual indicator of where the next tour stop, walk over to the stop and press the plinth’s button to change stops. All in all, this requires less cognitive load from the guide as rather than navigating the menu before moving to the next stop, they can move to it freely and change stops with one swift action i.e a virtual button press.

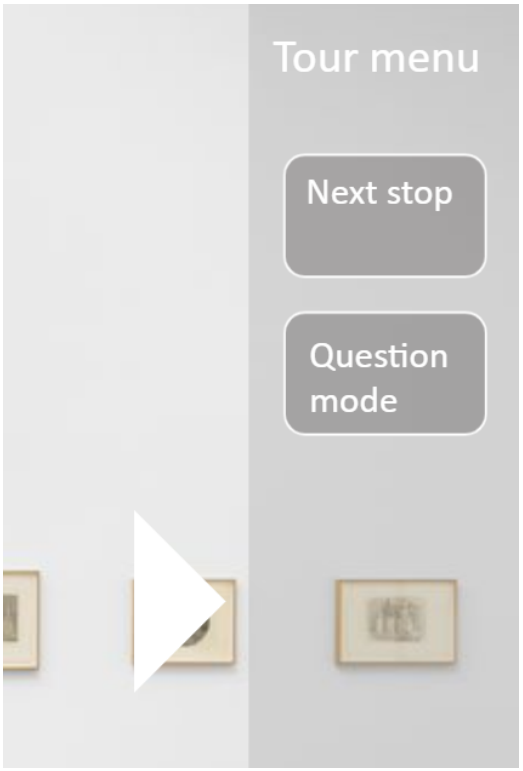


Figure 4: Old Menu Based, Tour Stop Switching Mechanism

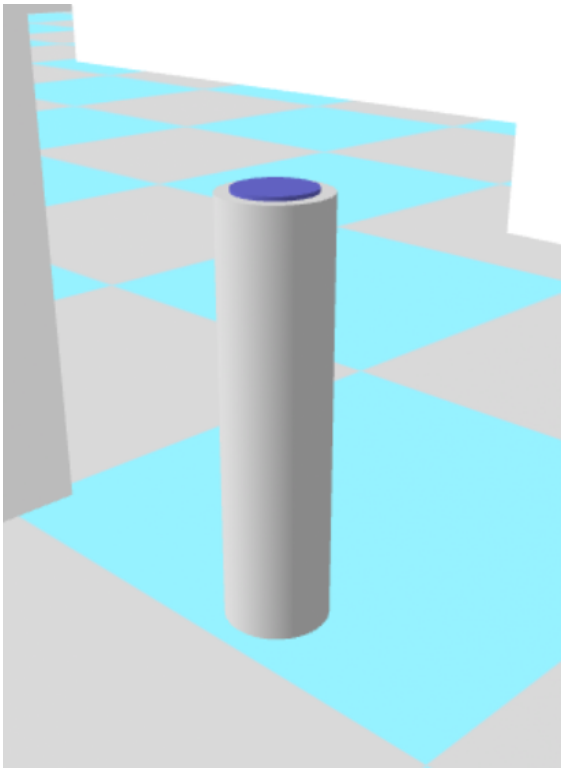


Figure 5: New, Virtual Plinth With Button to Switch Stops

Another way in which our design utilised AR's ability to integrate with the environment around us, was to mark all potential threats and subsequently identified threats with coloured outlines. This was a carryover of a good design decision made in the first iteration. However its implementation was made clearer through the use of a 3D environment for the prototype. The outline would be attached to the individual rather than appear as part of a UI display in the users center of vision.

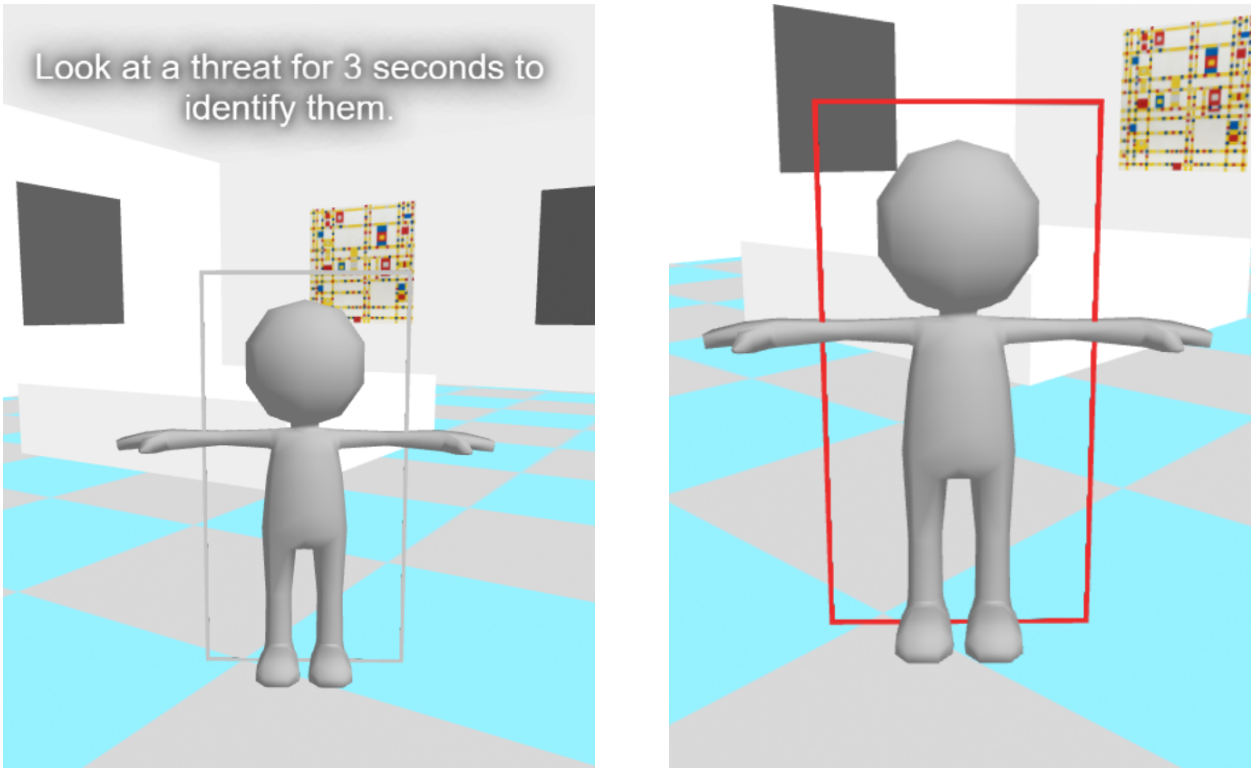


Figure 6: Potential Threat Identifier (on left) and Chose Threat Identifier (on right) During Threat Report Process

Designing Within The Peripheral Vision

Upon further inspection part of our team noticed that both the menu and HUD were located in the users peripheral vision. This would greatly affect their ability to read information from the displayed elements and interact with them. Ultimately the user could feel nauseous, frustrated and strained from such a UI display. Resizing Ui elements and placing them within the central or near-peripheral vision was a necessary change. The UI had to remain within the ventral vision however not take up so much space as to distract a user from their surroundings.

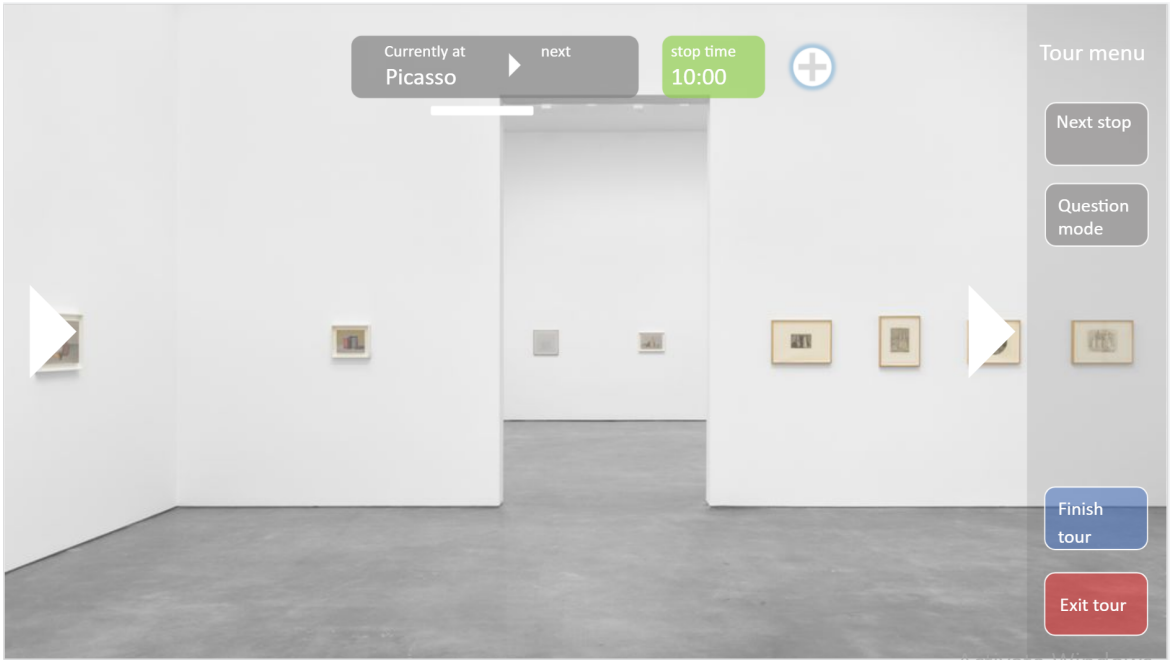


Figure 7: Old, low-fidelity, Menu Location. Situated in Zone of Peripheral Vision

Figure 8: New, high-fidelity, Menu Location. Situated in Zone of Central Vision

Clear and Consistent UI Design

Several testers of the first iteration noted that ui elements were not clear in their intent. They could not discern whether an element was actionable or simply used for display. Some icons were buttons while others were not, confusing and frustrating users. Users also noted that some buttons were dark coloured while others were white. The white buttons were also hard to see in front of light coloured surfaces (white walls, looking into a sunny window). For the second iteration, our team carefully considered the UI design so that all buttons had a standardised look and all display elements could be discerned from actionable ones. As a result all actionable elements (toggles and buttons) had a glow around them (figure 9), which intensified upon being looked at. Icons were only used on actionable elements rather than on display elements like messages or the question box (see figure 10). All elements were dark coloured, slightly transparent, and featured white text, allowing for good visibility under any lighting conditions. In dark environments the glow and white text would be clearly visible and under light conditions the dark background would separate the white text from the bright backdrop.

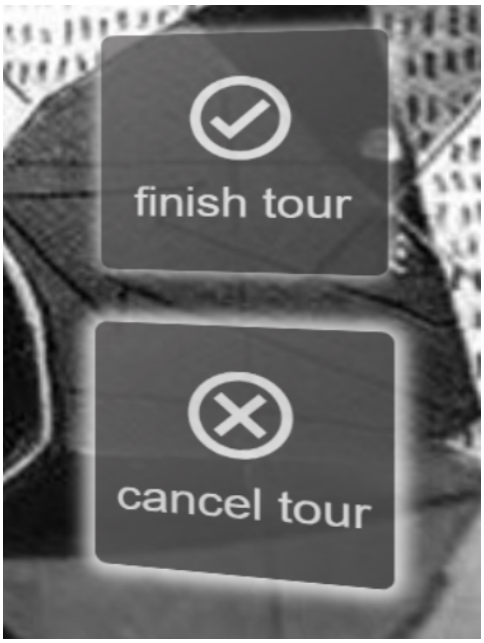


Figure 9: Menu Item Glowing Brighter When Looked At

Text size was standardised between all actionable elements and the hud. Different sized text was used for the question box (figure 10, above HUD) in order to fit a large amount of text within a specified area. Making the text as large as in the actionable elements would result in a cluttered central vision.

A standard set of colours was used throughout the design. Green, yellow and red was used to indicate one's timing at a stop (green being on time, yellow being running out of time and red being out of time). Red was also used for the report threat menu item as it indicated a sense of urgency. Blue was used for toggleable elements like the question mode and confirm buttons in prompts (figures 10 and 11).

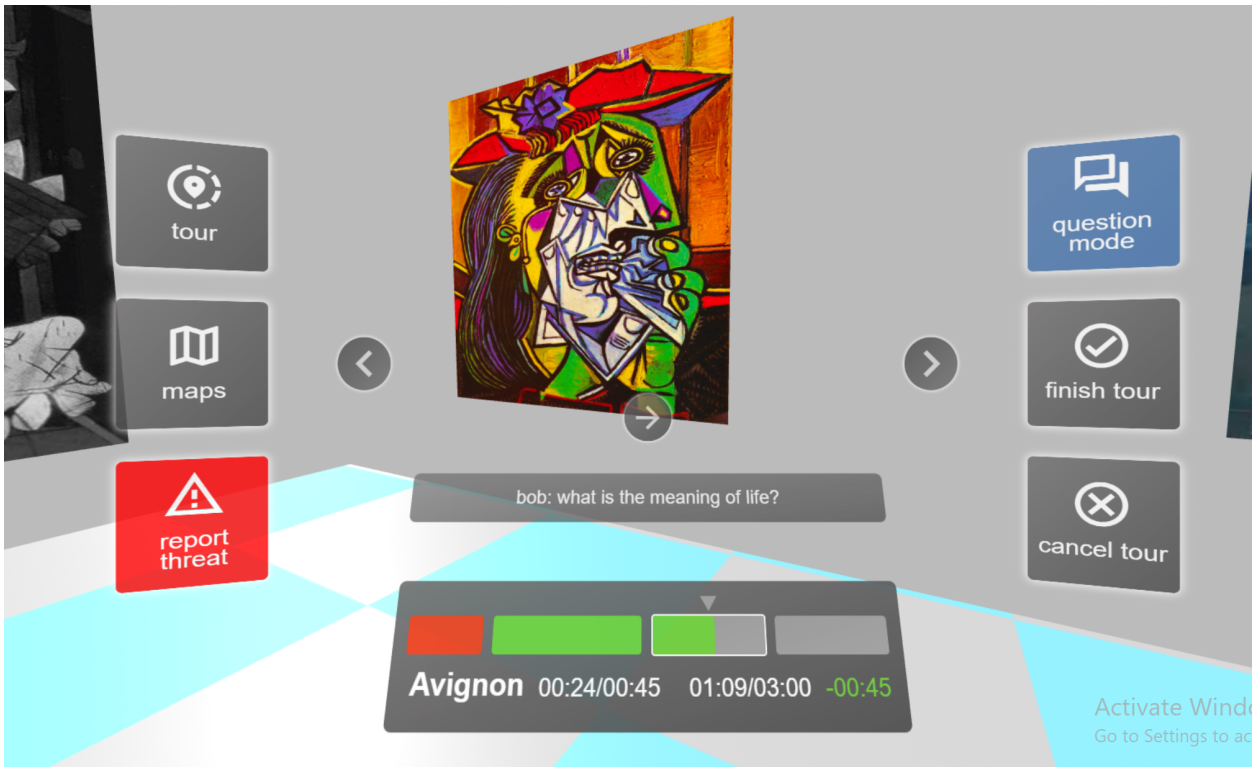


Figure 10: Majority of UI Design, Showing the Consistent Use of Elements Such as Color, Shape, buttons, Icons and Font

Use of prompts

Prompts were another carry over from the previous iteration, serving the purpose of error prevention. By displaying prompts at critical actions such as identifying a threat, selecting a threat level (figure 12) or canceling/finishing a tour (figure 11), the user was made aware of their perceived intentions and asked to confirm them. This way the user had an extra chance to change their mind or realise a mistake. At the same time any slip ups like accidentally choosing the wrong tour or threat, could be undone. As a result the user would not feel locked into their decisions and likely experience less stress and frustration using the application.

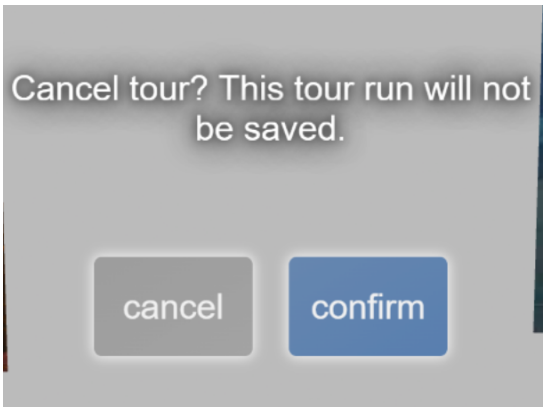


Figure 11: Decision Prompt Design

Figure 12: Threat Level Selection Prompt Design

Implementation/Prototype

The environment is generated in A-Frame, due to its simplicity in implementation and easy portability. The museum is a small set of white rooms with paintings, to provide a convincing and practical environment for testing the scenarios. The tour stops use a plinth as a "next stop" button, that is repositioned with each press. This was seen as preferable to a button in the HUD, as it acts as a physical marker to be guided by. The people in the environment use a basic 3d mesh and rotate to face the user, to provide some believability to the museum tour. Tourists with questions have an attached component that is displayed above their head, and is triggered by a mouse click to load the question in the tour display. We originally intended for a written response feature, but instead decided it unnecessary in a spoken environment, and kept question traversal to as few clicks as possible, so as to not overwhelm testers. Tourists designated as a potential threat have a trigger that will generate a border when they are hovered over, and a 3 second timer will turn the border red and call the threat information function. Moving your view away from the threat will reset the timer, but if it has already been triggered and turned red, it will stay locked on unless manually cancelled.

Evaluation

Our study of the interface prototype was conducted using a cooperative evaluation. All three users that we selected were from within the course as per the assignment requirements and ranged in age from 19 through 27.

It was difficult for us to be able to list the hardware used in the study as each participant used their own computers and did not know the exact specifications of the hardware.

Tour Guide Augmentation

Tour Guide Augmentation (TGA) is an augmented reality tool used to assist tour guides in conducting standard tours. TGA aims to better augment the guide's ability to: i)Track time management more efficiently ii) Report potential threats to relevant authorities in a discrete manner iii) Answer questions of the tour group in an organized and easily translatable format. In theory the user would access the interface via an augmented reality headset (such as HoloLens) and manipulate the menus and elements via either hand gestures or via eye tracking built into the headset.

A-frame testing

The prototype was constructed using A-frame, a framework based on top of html and javascript, to allow it to run on almost any modern web-browser. The participant was sent a link to a public domain with which any other individual with the link could view the prototype being used.

Without having access to an AR headset nor the time to implement a prototype on one, we conducted the evaluation using a HTML prototype and simulated hand gestures and eye tracking via the mouse to the best of our abilities.

Evaluation Procedure

Before conducting the evaluation, each participant was given a consent form that briefly outlined the purpose of the study and the use of the gathered data in addition to consent to having a screen capture recording for us to review. Given the conditions imposed on us from COVID-19 we did not feel the need to exclude individuals on medical grounds as the evaluation was conducted online.

On starting the evaluation, the user was given a brief on the scenario they were presented with (depending on which they were testing at the time), and a public domain link that would allow them to view and interact with the prototype while team members were able to observe.

For Scenario 1, participants were asked to:

1. Start the tour
2. End the tour
3. Gauge time management during stop
4. Gauge your progress on the tour
5. Update your progress on the system

For Scenario 2, participants were asked to:

1. Initiate the threat reporting procedure
2. Identify the threat
3. Identify the threat level
4. Lodge the report

For Scenario 3, participants were asked to:

1. Open Question Mode
2. Select a question to answer
3. Answer a question (mock answer)
4. Close question mode

The participant was then briefed on the process of a think aloud protocol and the cooperative method of the evaluation.

The evaluation was then conducted via VOIP on Discord to allow us to communicate with the participant, and a public domain link to allow us to view and record the user's interactions with the interface.

The participant was then given scenarios one, two and three in order and upon completing the previous scenario. Once the participant had completed all the tasks in each of the three scenarios, they were asked to complete a questionnaire containing questions about their thoughts on the interface and its implementation.

Informed Consent Form

The below consent form would have been used if testing was done in person

_____

You are invited to participate in the usability testing of an interface for an augmented reality application. The application is intended for the use of tour guides at an art gallery. The purpose of the study is to find the well designed and poorly designed parts of the interface.

As a participant of the study, you will be given a briefing on the role of the tour guide and the core concepts of the application. You will then be given a set of tasks to complete under three separate scenarios concerning your role. You are encouraged to adopt a think aloud protocol, speaking out any thoughts you may have. A tester will ask you to complete a task and voice out your thoughts and questions as you do it. They may instead ask you to voice your logic when completing a task. Once all tasks have been completed, you will have a questionnaire to answer to complete and can voice any remaining thoughts.

We are looking to test 3 participants within the seng2260 course. No participant can be a group member from the testing group, team Andor. The test will run for approximately 20 minutes, where the participants voice and their devices screen will be recorded.

All collected information will only be used for the purpose of this study. No information will be distributed beyond the members of the reporting group, team Andor, and all recording will be deleted on the due date of the report (29/10/21). Your name will be omitted from the report.

I _____ have read the conditions of this usability test and hereby agree to participate.

Signature

_____

Testing ‘Script’

Start:

- Give the participant consent form
- Give Participant briefing
- This is an cooperative evaluation so we encourage a think aloud protocol
- Supply Participant with public domain link

NOTE: at any point you can ask for a participants through process in completing a task

Scenario 1

- Ask the participant to start the tour (Record number of clicks and approximate time and any think aloud notes)
- Once done, Ask participant to gauge how much time they have remaining on a specific stop (Record time and accuracy)
- Ask participant to progress to the next stop
- Ask participant to gauge progress of tour overall
- Ask participant end the tour

Scenario 2

- Give participant briefing
- Ask participant to engage threat reporting
- Have participant identify and tag a specific individual
- Ask participant to Rank threat level
- Have participant submit threat report

Scenario 3

- Give participant briefing
- Ask participant to open question mode
- Ask participant to select question to answer
- Ask participant to submit mock answer
- Ask participant to close question mode
- Give participant questionnaire

Questionnaire

On a scale of 1-5 (1 being strongly disagree and 5 being strongly agree):

1. Did you feel the UI elements were an appropriate size?
2. Can you connect the look of a menu item with the action performed?
3. Is it recognizable what state the system is in? (I.e question mode)
    a. Tour
    b. Question
    c. Threat
4. Do you feel anything was distracting?
5. Were the colors used helpful?
6. Did you feel lost while navigating the UI?
7. Was the system easy to use?
8. Did you feel frustrated at any time?
9. Did you feel that you could rectify any mistakes?
10. Were the prompts clear in their instruction/intent?
11. Did you feel that the threat reporting was discrete?
12. Did you feel that the tasks you were given were made easier by the AR?
    a. Tour
    b. Question
    c. Threat

Questionnaire Results

Question	Rating				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1					III
2				I	II
3a			|		||
3b		|	|		|
3c		|	|		|
4	III				
5					|||
6	I	I		I	
7				II	I
8	I	I	I		
9		I		I	I
10				I	II
11					III
12a					III
12b					III
12c					III

Table 1: Questionnaire Result, with Tallies for Answers

Observations

Participant A

Scenario 1

- Ask the participant to start the tour (Record number of clicks and approximate time and any think aloud notes)
    - 3 Clicks (Par), 36 seconds
    - Immediately went to left hand menu and assumed ‘tour button’ started it
    - 54 seconds to find and interact with first plinth
- Once done, Ask participant to gauge how much time they have remaining on a specific stop (Record time and accuracy)
    - ‘Looks like I have 30 seconds on the first’
    - ‘Looks like I’m over time on the intro’
    - ‘Looks like there’s 3 stops of varying size’
- Ask participant to progress to the next stop
    - ‘Immediately assumed clicking on the next stop displayed information concerning it
    - Able to identify what next stop is
    - Needed light instruction to understand plinths
    - Able to navigate to next plinth
- Ask participant to gauge progress of tour overall
    - “Looks like I’d behind by 1:27”
    - Understood when stops finished
    - “Looks like I’m catching up slowly”
    - Able to see total ‘over time’
    - Able to immediately identify method of reviewing previous stops
    - Colours allowed easy identification of ‘on time’ or off time status
- Ask participant end the tour
    - Struggled to find final plinth (positional)
    - Opened the left menu and interacted with tour instead of right and end tour
    - Did not understand right menu was contextual

Scenario 2

- Ask participant to open question mode
    - Immediate assumption toggle was in right hand context (verbalized)
- Ask participant to select question to answer
    - I should attend to blue first
    - After attempting to interact with blue realised blue means active
- Ask participant to submit mock answer
    - Felt the feature seemed redundant
    - Attempted to use context menu
    - Arrow to answer question was not immediately obvious
    - Attempted to click on question text
- Ask participant to close question mode
    - I guess there are no more questions
    - I would have expected to turn it off via arrow
    - Able to identify question mode is off

Scenario 3

- Ask participant to engage threat reporting
    - Initially attempted to interact with individual
    - “That’s where I expected it to be” upon opening right hand menu
- Have participant identify and tag a specific individual
    - Immediately assumed interaction with the individual
- Ask participant to Rank threat level
    - Understood how the threat ranking system worked
    - “Seems like a lot of clicks”
- Have participant submit threat report
    - Want there to be there a little threat indicator that shows threat was reported successfully
    - Able to identify cancel report was contextual menu

Participant B

Scenario 1

- Ask the participant to start the tour (Record number of clicks and approximate time and any think aloud notes)
    - Participant did not understand collapsable menus (symbolized by arrows) were in fact menus and not a method of navigating the virtual space
    - Start of tour was not obvious (verbalized)
- Once done, Ask participant to gauge how much time they have remaining on a specific stop (Record time and accuracy)
    - Element turned red means over time (verbalized)
    - Some confusion about stop indicator (arrow above stop)
- Ask participant to progress to the next stop
    - Understood that the plinths would progress tour to next stop
- Ask participant to gauge progress of tour overall
    - Had difficulty understanding time management and number to stops
- Ask participant end the tour
    - Immediately accessed right hand menu to end tour

Scenario 2

- Ask participant to engage threat reporting
    - Immediately access left menu and went straight to report threat mode
- Have participant identify and tag a specific individual
    - Assumed that eye contact with individual would mark them
- Ask participant to Rank threat level
    - Understood ranking system
- Have participant submit threat report
    - Felt confident that report was sent successfully

Scenario 3

- Ask participant to open question mode
    - Understood without instruction that right hand menu would not function without an active tour
    - Assumed position of question mode was correct
- Ask participant to select question to answer
    - Able to immediately identify that blue mark indiciated active question
- Ask participant to submit mock answer
    - Immediately assumed arrow about question text progressed to the next question
- Ask participant to close question mode
    - Knew to access right hand menu and toggle question mode off

Participant C

Scenario 1

- Ask the participant to start the tour (Record number of clicks and approximate time and any think aloud notes)
    - Immediately accessed the left hand menu to access tour mode
    - Knew to interact with plinth to begin tour
- Once done, Ask participant to gauge how much time they have remaining on a specific stop (Record time and accuracy)
    - ‘Did not initially see the progress bars’
    - Mistook arrow above stop as expected time
    - Assumed green colors referred to being on time
    - Understood yellow meant that time was running out
    - Understood that red meant that they were over time
- Ask participant to progress to the next stop
    - Knew to interact with plinths to progress
- Ask participant to gauge progress of tour overall
    - Understood total number of stops from the HUD
- Ask participant end the tour
    - Knew to finish tour via plinth

Scenario 2

- Ask participant to engage threat reporting
    - Attempted to use right hand menu
    - Second attempt was left hand menu
- Have participant identify and tag a specific individual
    - Understood action to tag individual
- Ask participant to Rank threat level
    - Understood threat level ranking
- Have participant submit threat report
    - Confident that threat report was submitted (verbalized)
    - “Two confirmations asking if I was sure, red outline, I felt satisfied the report was sent.

Scenario 3

- Ask participant to open question mode
    - Attempted to find question mode in left hand menu
    - Second interaction was with right hand menu
- Ask participant to select question to answer
    - Able to identify highlighted question as current active question
- Ask participant to submit mock answer
    - Immediately assumed arrow above question progressed to next question
- Ask participant to close question mode
    - Immediately accessed right hand menu to toggle question mode

Results

The average time of each test was 18 minutes and 21 seconds. During this time the participants were supplied with an open domain link to the prototype and asked to stream a screen capture for us to view via discord. A member of the team would then record this stream (with the participant's consent) for later reviewing.

During the testing, a team member was recording their observations of the participant's interaction and think aloud process with the interface, these notes were later supplemented by a review of the recorded screen capture we asked of the participants.

In the testing, we identified 8 potential usability issues that will need to be address in the next interaction of the interface design:

1. Users failed to understand without instruction the purpose of the plinths within a room
2. The arrow to progress question mode to the next question did not stand out enough or it's intent was not clear
3. Threat reporting required a high number of interactions in a potentially stressful situation
4. Successful submission of threat report was not clear
5. Intent of collapsable menu icons were unclear
6. The arrow used to indicate which stop the participant was current on cause some confusion
7. Some difficulty understand progress bars and time management
8. Not understanding purpose of left and right menus without instruction

Of these 8 issues we could then further categorise them by Low Quality and High Quality issues. Low quality issues could likely be overcome with repeated use of the system or some training, while High quality issues would likely persist even after repeated use or training. The number in each cell refers to the number of observations or verbalized issues concerning the issue.

Issue / User	Issue 1	Issue 2	Issue 3	Issue 4	Issue 5	Issue 6	Issue 7	Issue 8	Total
User A	1,L	1,L	1,H	1,L	-	-	-	-	4
User B	1,L	-	-	-	1,L	1,L	1,L	1,L	5
User C	-	-	-	-	-	1,L	1,L	-	2
Total	2	1	1	1	1	2	1	1	11

Table 2: Issue Quality Matrix

Across the three tests with the participants, 11 issues were identified of which the most common 2 were:

1. Issue 1: Users did not understand the purpose of the plinths
2. Issue 6: Arrow used to indicate current stop causes some confusion

Reviewing the quality of these issues it is obvious that both are low quality issues and could be resolved with some prior training in the use of the interface or given further instructions.

However, Issue 1 related more to the position or even marking of virtual objects in the gallery space rather than the interface itself, the issue could potentially be rectified by highlighting the objects in a more obvious fashion or by changing the method of progressing the tour to something much more automated.

Additional, Issue 6 related to feedback concern the state the system was currently in, specifically the particular stop the user was on. The issue could be potentially resolved by adding text to above the arrow indicating its purpose. Regardless, further testing would be required.

Lastly, during the testing with participant B, a portion of the prototype failed to instantiate and needed to be reloaded after the user had some minor interaction with the system.

Reflection

Through the entire course of the iterative design process, the team both designed and created multiple prototypes of an augmented reality user interface, operable by an art gallery tour guide. This process gave us the opportunity to learn through experimentation in a procedure similar to that carried out by companies within the real world. The cyclic nature of the flow of events made this process of reiteration an understandable, yet infinitely scalable tool usable in any context where design is necessary.

Learning Outcomes

Looking back on the design and construction of both the low-fidelity prototype and hi-fidelity prototype, the team learnt:

- **Different people have different opinions**. Although this was known already, it was further reinforced through user testing whereby many of the testers had their own ideas of intuitive concepts. This diversity of feedback is natural and influenced by many factors including: culture, age, race, gender, etc.
- **Iterative design process outlines improvements more effectively**. Due to the nature of the process, reviewing previous work through testing and team exercises helped the team better understand what needed to be improved in black and white. Once any type of prototype for a component has been made, the teams reviewing phase essentially acts as the first step to get the ball rolling.
- **Keeping everyone up-to-date is important**. As prototyping is considered a fast paced development environment we learned that ensuring all the team members are on the same page is very important. To make sure we had all members up to date regular meetings would occur Wednesdays after class and supplementary ones whenever necessary. As the workload increased, the team would split into multiple groups to work on different parts, the learning outcome was especially important here.

- **Accountability and teamwork.** Working with a team showed and helped us solve difficult problems. Being able to brainstorm ideas and get many different perspectives was critical when designing prototypes. Additionally, making sure everyone in our team was keeping on track and completing their tasks was important. Making sure people were accountable for the work they did will be reflected in the meeting minutes.

- **Problem Solving**. The team was able to problem solve by firstly identifying what needed to be done. Then defining the problem for example understanding the risks of the prototype. Then exploring possible ways we can solve the problem. Then taking action which could be in the form of sending two people to work on it. This would break up

larger problems and allow the team to work through them. Finally we would reflect and look back at our solution and analyze what could be done differently.

- **Learned more about the importance of HCI with use of UI - AR system.** From the course we have learned a great deal about the importance of HCI when it comes to the use of UI/ AR systems. The two prototypes we created cemented the idea of the enchcedmanes that this kind of technology can bring to people. Additionally the study's we had to review also details the imporce the AR system and how they are beneficially impacting society.

- **Learn standard practices of how to design UI** We have been able to get a better understanding of what the user wants and needs. This course has helped us ensure our interface elements are easy to access, understand and use. An example of this is the use of a context menu throughout and prototypes.

- **How to use affordances to make intuitive designs** Through the prototypes we have used affordances to enhance our designs. These have often been used in combination with the design standards to create a design that is easy for the user to understand and use effectively. This additionally ties to the gulf of execution and our designs being sound for the user.

Improvements

- **Doing the course on campus.** Covid-19 has stopped us from doing the course in person. As a result there were some disadvantages to this. For example we were never able to use or get the feeling of theAR technology which prohibited certain ideas when it came to the prototype cenarios. As well as doing testing face to face would have been easier to obtain data from testers**.**

- **Scheduling.** Sometimes our team scheduling could have been improved. We were often having to finish tasks for the report on the last day. People wouldn't always attend meetings. Many of these issues may have been caused because the course had to be online or a large team size.

Meta-level Decisions

The Meta-level decisions outline appropriate approaches to certain tasks, rather than decisions about the tasks themselves. The team encountered and used many prototype techniques, applying them towards underdeveloped elements of the project discovered using risk assessments, user testing and realisation of complex components. These decisions also lead the team to determine how we evaluated the results of our observations and guided us to understand what the next steps would be.

Prototyped Features

The understanding of which features within the UI that needed to be further prototyped was perhaps the most important part of the transition from the low-fidelity to the hi-fidelity prototype. To find these underdeveloped features, the team focused on:

- **Complex features**. Complex features were components of the user interface which required more fleshing out, these features were generally realised before testing had begun. Complexity of the components was understood when a linear progression of the interface behaviour was not possible, for example, the tour HUD had multiple moving parts within its own subsystem.

- **Troubling features outlined by testing**. Through user testing and analysis, observations were made about the usability of various components within the prototypes that perhaps didn't match a tester's intuition. We, as a team noted these preconceived ideas the tester had about the various features as improvements to be made. These features need to be prototyped further to allow a smoother gulf of evaluation and/or understanding of the components.

- **High risk features**. The high risk features of the prototypes outlined using a risk assessment allowed the team to target components which needed further prototyping. These risky features did allow for innovation within typical UI but it was the team's job to ensure these components were streamlined and closely matched towards user affordances. Implementation of symbols was useful in this case.

Prototype Techniques

The team experimented with a few prototyping techniques, these techniques were used as a framework when beginning the process on a particular feature of the interface. The included:

- **Online Sketching**. Online sketching was a technique that allowed the team to put thoughts and ideas into visual prototypes. This allowed the team to rethink their thoughts and extract details about the prototype that sounded great in theory but either difficult or unusable in practice. This tool was incredibly useful when constructing primitive designs and was usually the start of every component's implementation. The team used tools such as paint and powerpoint as a means to accomplish this, for example:

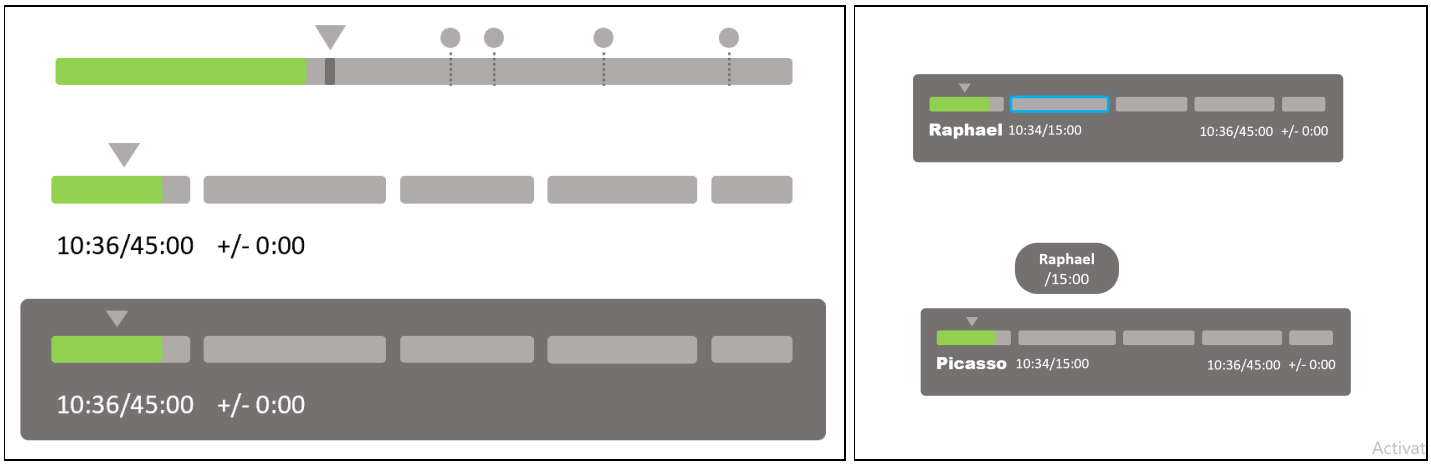


Figure 12: Online sketching example: experimenting with different designs of tour HUD

- **Storyboarding**. Storyboarding was a technique used by the team to outline the flow of events in a step-by-step manner. We used storyboarding for the flow of events in our low-fidelity prototype, as well as some use in further understanding of complex features mentioned above. To utilise this technique the team used microsoft powerpoint as everyone was familiar with the tool, thus rapid prototyping was easier (mentioned next).

- **Rapid Prototyping**. This form of prototyping encompassed the majority of the development for the features aforementioned, this rapid prototyping utilised both storyboarding and online sketching. The team used this approach as there was limited time with execution of the projects and ensuring fundamentals are as fine tuned as possible was more important than other features.

Risk Assessment

The primary risks of interface use include confusion and difficulty in navigation, excess information, ensuring ease of use for extreme circumstances. We were able to discover the risker parts of the prototype from user testing. This was either in house testing from people that worked directly on the prototype itself or outsourced to other people in the course. From this we were able to record and analyse data which we used to determine the risks within the prototype. Once we understood all the risks with the prototype we listed in order servierty from highest to lowest.

- **Threat reporting procedure**. This procedure continues to be the most risky part of the system because it is used in emergency situations. Users must be able to easily find the button to initiate the process, make their way through reporting a threat and not make any mistakes when making a report.

- **Menu design**. We considered it to be one of the most risky parts of the system. because it is one of the most handled and used parts of the system. This needs to work seamlessly with all functions and processes in the system. Additionally, everything for the user needs to be easy to find and cause zero confusion when navigating.

- **Question and answering process**. The main concern is ensuring every question is answered, and that each user has confidence their question is being handled, without overwhelming the users with written information. The design needs to reduce unnecessary information, to allow the tour guide to efficiently handle the questions given.

From this you can see some of the meta-level design decisions that went into our group discovering the risks of prototypes and how we needed to overcome the tasks.

Result Evaluation

To evaluate the results uncovered via usability testing, the team have developed a scaffold to follow. This scaffold is a step-by-step process which goes from finding the relevance of an issue users faced to providing a solution for this issue.

1. First we ask ourselves "**is the problem relevant**". This will decide whether we follow this problem further or just leave it as there may be higher priority issues with the user Interface.
2. If the problem is relevant, we ask ourselves "**Can the component be redesigned?**" This will determine whether we reconsider a redesign of the component.
3. If the problem cannot be redesigned, we ask ourselves "**Can we create an alternative?**" This will determine whether we can find a different solution which fixes the issue.
4. If none of these will result in the problem being rectified, the team will reconsider the entire role of the component within the UI.

Future Plans

Threat Report Process

We identified that the threat reporting required a high number of interactions in a potentially stressful situation. This can be resolved by reducing the number of steps taken to identify a target, making the report process more linear by having only 1-2 interactions but giving the guide an option to cancel a submitted report.

The team observed that successful submission of the threat report was not clear. This can easily be redesigned to prompt the guide with a notification stating that the threat has been reported and security/emergency services are on their way (this was intended to be a feature within the system, but due to time constraints was not implemented).

Menu Design

Users sometimes didn't understand the left and right menu buttons without any instructions. While we still believe the menu system is intuitive and easy to use, the affordances we implemented for accessing the menu were foreign to users. The conceptual model is sound and with the user using the system more then once they will be able to get a good understanding of their purpose and how they work.

Question Answering

Testers mentioned that the arrow to progress question mode to the next question did not stand out enough or it's intent was not clear. This issue can be rectified by positioning the arrow to a more suitable location, making the arrow a more universally identifiable symbol, or changing the colour of the action to give a more clear indication of what state the guide is in.

HUD Design

There was minor confusion when it came to understanding how the progress bars and time management worked. In future designs making it more of a minimal design will cause less initial confusion when looking at the hud. We could potentially add a pop out menu that carries more information about the time management e.g. time left on tour and time until next stop. This should simplify the menu when users first have to interact with it.

Observations found the arrow used to indicate which stop the participant was currently on caused some confusion. The guides will be taught basics on how the HUD design runs, thus this is a minor issue. Another alternative would be to perhaps highlight the stop we are currently at with a small glow effect around the border, this avoids any confusion with arrows positioning.

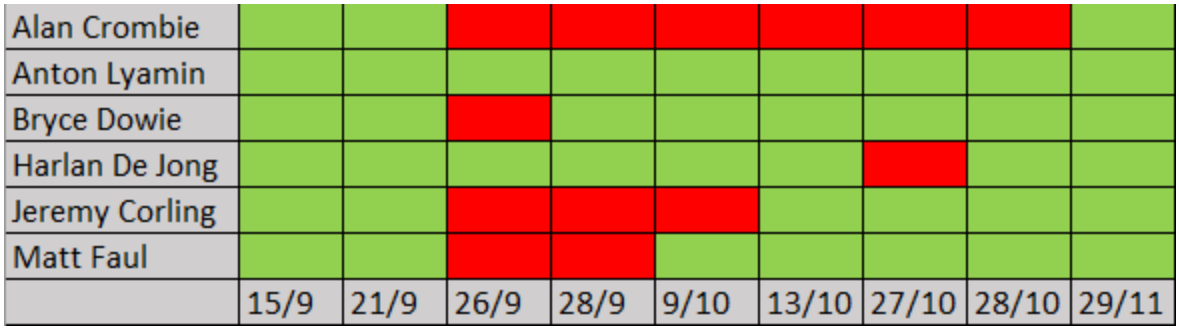
Changing Stops Mechanic

Discovered in the results, when the testers wanted to change stop, they found that the plinth was not an intuitive way of doing so. A solution to this would be to provide extra information to the tour guides HUD, whether this be a minimap or waypoint outlining the location of the next stop.

Conclusion

Through designing, prototyping and evaluating a user interface for three scenarios considering the Hololens 2 system, the team has viewed the impacts of Human-Computer Interaction (HCI) and User Experience (UX). A problem domain, design layout and implementation was completed, this breakdown and assessment of interface design allowed the team to find a balance within the interface. Testing of the high-fidelity interfaces for each scenario was carried out by a third party and observations were made by the team to find good and bad points within the prototypes. After the testing, an evaluation and reflection design solutions were discovered.

Minutes and Summary of Meetings



Alan Crombie									
Anton Lyamin									
Bryce Dowie									
Harlan De Jong									
Jeremy Corling									
Matt Faul									
	15/9	21/9	26/9	28/9	9/10	13/10	27/10	28/10	29/11

**Note: Unlisted meetings were typically follow up meetings

Roles:

Group leader: Anton

Scenario designers/operators: Anton, Matt, Jeremy

Minute keeper:Harlan, Alan

Tester / formatter: Bryce, Harlan

Observer: Matt, Harlan, Bryce

Meeting Minutes ..
Date: 15/09/21
In attendance: Alan, Anton, Bryce, Harlan, Jeremy, Matt
Key takeaways: Assignment Specifications
Action Items: Review previous assignment for improvements

Summary:
First meeting for A2, going over areas of A1 and how to cover A2.

Meeting Minutes ..
Date: 21/09/21
In attendance: Alan, Anton, Bryce, Harlan, Jeremy, Matt
Key takeaways: Decide on using A-Frame
Action Items: Discuss software to use, Delegated tasks

Summary:
Examine possible software to use for scenario development, decided on A-Frame. Delegated various tasks between members.

Date: 26/09/21

In attendance: Anton, Harlan
Key takeaways: Getting a better understanding of A-Frame
Action Items: Delegated tasks, learn more about the software

Summary:

Group member are testing the software and learning more about how it works

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Date: 28/09/21

In attendance: Anton, Bryce, Harlan
Key takeaways: Bryce understanding the software
Action Items: teaching bryce

Summary:

Antone is teaching more group member how to use A-Frame

Date: 09/10/21

In attendance: Anton, Bryce, Harlan, Matt
Key takeaways: prototype being made
Action Items: Prototype is starting to be made

Summary:

Anton, Bryce and Harlan are making the prototype. Matt is starting to make report and presentation

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Date: 13/10/21

In attendance: Anton, Bryce, Harlan, Jeremy, Matt

Key takeaways: Finishing prototype and presentation need to be finished
Action Items:

Summary:

Anton and Bryce finish the prototype. Jeremy , Matt and Harlan finish the presentation and do more work on the report

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Date: 27/10/21

In attendance: Anton, Jeremy, Matt
Key takeaways: Evaluation testing
Action Items: Evaluation of UI

Summary:
Set up usability testing for tomorrow, finalised evaluation of UI and usability testing

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Date: 28/10/21

In attendance: Anton, Bryce, Harlan, Jeremy, Matt
Key takeaways: Usability testing
Action Items: Usability testing conducted

Summary:
Usability testing was conducted on the prototype by a user

Date: 29/10/21

In attendance: Alan, Anton, Bryce, Harlan, Jeremy, Matt
Key takeaways: Conclusion and Formatting
Action Items: Finalising the report

Summary:
Combining the relevant documents and finalising the report

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