Augmented Reality Museum

Thomas-Daniel Borg (Author)
Group Leader
Gżira, Malta
TB638@live.mdx.ac.uk

Nathaniel Schembri
Group Member
Birżebbuġa, Malta
NS1098@live.mdx.ac.uk

Jeremy Vella
Group Member
Mġarr, Malta
JV248@live.mdx.ac.uk

ABSTRACT
This paper describes the development of an augmented reality experience into museum application. The basic idea behind this project is to integrate knowledge and appreciation of the arts presented in this museum with augmented reality. Using this technology, the exhibits are enhanced by multimedia and interactive information to increase the experience of the user.

Author Keywords
Augmented Reality; Vuforia; Exhibits; Handheld; Unity; Interaction; Overlaying; Haptic Feedback.

INTRODUCTION
This project offers users attending the National Museum of Fine Arts an augmented reality experience of the exhibits present within said museum. Many different media will be used to enhance the experience of the users.

RESEARCH
The Museum selected for this project was the National Museum of Fine Arts situated in Valletta. The museum presents exhibits having many different aspects and features dating from the Late Medieval period to the contemporary. The building was one of the earliest to be built in Valletta and served as residence to successive knights of the Order of St John.

DESIGN CONCEPT
A number of features were decided to be implemented in this project with respect to our research and findings at the museum as to build an augmented reality experience suited for the museum chosen.

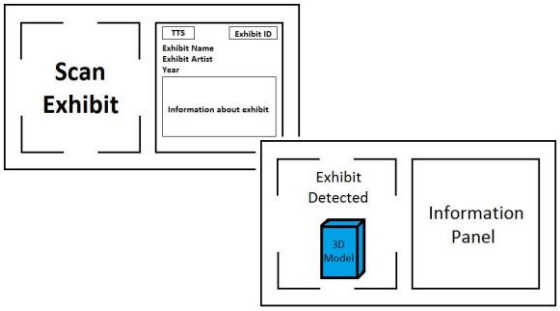
The application will be comprised of what Unity Engine calls 4 scenes in total. The Menu, Play, 'Where Am I' and Quiz scene.

The Menu scene will include a camera feed together with three buttons, two of which will take the user to the Play and 'Where Am I' scenes and an exit button which will kill the application. A dropdown box is also to be shown for the user to choose between three in-build languages, English, French and Italian. Three rotating cubes were also added to the scene overlaying the camera feed containing three of the exhibits that are shown at the museum as shown in the figure below.

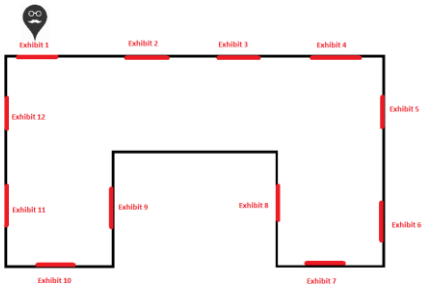
The main objectives were to present the user with a brief description of the exhibits which should be properly overlaid on the smartphone's screen. This was done in the Play Scene where the user is required to scan the exhibit using the handheld's camera. When the exhibit is recognized, the handheld device will vibrate as to give haptic feedback to the user. He is then presented with all relative data such as the exhibit name, painter name and basic information about the exhibit. A speech button near the exhibit description is available to offer speech functionality. The speech functionality can either be stopped by pressing a separate 'Stop Speech' button or lose focus of the scanned exhibit.

The Share button will allow the user to take a screenshot of the exhibit with, if any, augmented reality media to be shared through third party applications such as Facebookand WhatsApp installed on the device.

The Augmented reality experience is offered through 3D models, overlaying data about the exhibit, sound effects, animations and the text to speech functionality. The 3D model will be overlaying the actual exhibit as can been seen in the design concept below.



The 'Where Am I' Scene allows the user to scan the closest exhibit found next to the user and the application will then show the user's location with respect to the scanned exhibit. A sketch of this is shown in the figure below where the user has scanned Exhibit 1 and the application returned a map with the marker pointing to Exhibit 1.



PROTOTYPE

The Play Scene was implemented in quite a number of stages. After deciding which of the exhibits had the highest rating, a data set was imported into the Unity project together with an API key which is required for Vuforia SDK. Using the information for each of the exhibit that was found in the research stage, a database was created which includes three tables, one for each language. The packaged SQLite connections that come with the Android SDK was used to save this database. Connections to this database were made when successfully recognizing an exhibit, which selects all the relevant data as per scanned exhibit ID. The figure below shows one of the tables available in the database.

Database Structure | Browse Data | Edit Pragmas | Execute SQL

Table: exhibit

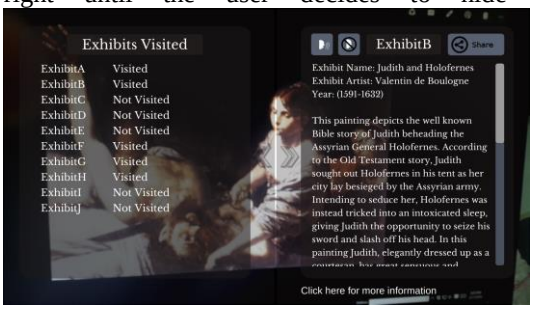
	exhibitID	exhibitArtist	exhibitYear	exhibitName	exhibitDescribtion	exhibitUrl
	Filter	Filter	Filter	Filter	Filter	Filter
1	ExhibitA	Claude-Joseph Vernet	(1714-1789)	Fire on the Tiber	The painting depicts ...	http://www.e...
2	ExhibitC	Favray, Antoine de Create	Late 18th Cen...	The Musician	The name of the Mal...	http://www.e...
3	ExhibitB	Valentin de Boulogne	(1591-1632)	Judith and Holofernes	This painting depicts...	http://www.e...
4	ExhibitD	Do Menico Guidi	(1625- 1701)	Pope Innocent XII	A marble Portrait Bu...	http://www.h...
5	ExhibitE	Cosimo Fancelli	(1620 - 1688)	Saint Catherine of Siena	This small reliquary ...	http://finearts...
6	ExhibitF	Unknown French	16th century	Fra Pierre de Cluys Chalice	This French, early 1...	http://finearts...
7	ExhibitG	Corelli, Corrado	Early 20th cen...	Oxen	Realistic looking Oxe...	http://www.e...
8	ExhibitH	Giovanni Domenico Lombardi	(1682-1752)	Annunciation	The painting depicts ...	http://finearts...
9	ExhibitI	Eugenio Maccagnani	(1852-1930)	Leah	Leah was one of the...	http://finearts...
10	ExhibitJ	Giuseppe Vermiglio	(1587-1635)	Cain and Abel	The painting of Cain ...	http://finearts...

Each exhibit has a type of media that relates to the exhibit subject that is being scanned. Exhibit B below shows a painting of 'Judith and the Holofernes' and as can be seen below, a 3D model of the sword is rendered in real time. In exhibit, an angel is rendered holding an animated torch.

Exhibit G will play a sound effect that related to the natural sound that an oxen makes in real life. Due to the speech functionality, the sound effect was made to be short and will also immediately stop once the TTS button is clicked.

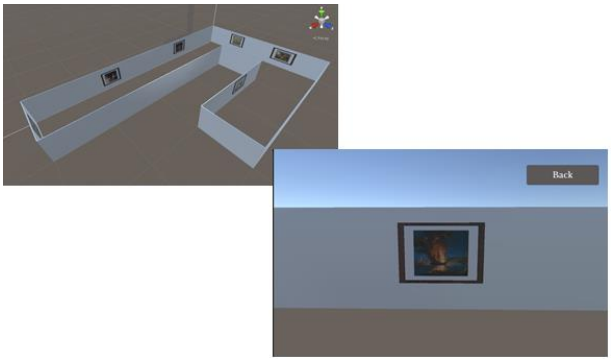
Exhibit F highlights renders a chalice with an animated host that is floating within the chalice. Exhibit A renders a ship on animated fire. Improvements was done to this particular exhibit. A slider was added as can be seen in the image below. This will allow the user to have a 360 degree view of the ship.

When an exhibit is visited, the system saves the ID in the applications memory known as shared preferences. This is done so the application can show which of the exhibits were and were not visited. This is shown in a panel that is by default hidden as to not obstruct the main screen. Upon clicking a side arrow, the panel will animate and slide to the right until the user decides to hide it again.



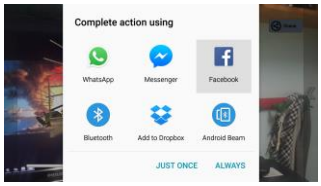
Each exhibit has an extra SQLite query which check whether the currently scanned exhibit has any similar exhibits and these are listed in the description panel underneath the description. The link is done with the artist name of the exhibit.

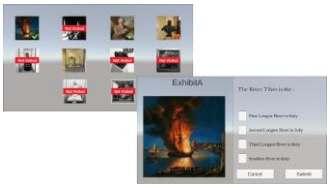
The 'Where Am I' scene work in a similar way like the play scene but offers slightly different functionality. Upon scanning the exhibit, rather than showing information, the ID of the exhibit is saved in memory and a bird-eye view of a 3D model of the museum is shown. An animator will the move the main camera towards the scanned exhibit location. These can be clearly seen in the below images.



It was decided to add more languages to the project. This is a feature that is fully supported in the TTS engine. All the data was converted to the language the user decides to choose at the Menu scene. This is saved as a shared preference and all text is also translated. The TTS engine also takes the accent into consideration.

The sharing functionality was implemented from an idea to allow the user to take photos of their friends together with the rendered 3D model. An example of this could be seen by rendering a 3D model of the famous artist that pained the exhibit and taking a photo with the artist and uploading it to their favorite social media application. The sharing functionality uses the device's method of communication, third party applications and also the device's interior sensors such as Bluetooth or Android Beam. This can be clearly shown below.





Another scene was added to offer a gamification experience to the users attending the museum. A quiz offering a question on each exhibit with a choice of answers that needs to be selected. Each answer is stored in the Sqlite database whereas the question and answers are stored in the application. It is to be noted that a question is only available once the exhibit has been visited. When an exhibit is not yet visited, the question for that exhibit is disabled.

TEAM WORKING

The team was comprised of three members, myself, Nathaniel Schembri and Jeremy Vella who each had specific tasks appointed.

My appointed work load was the implementation of the main program using the Unity engine and the Vuforia Plugin. Such implementations include UI concepts, displaying of the 3D models and their animations, displaying of the exhibit information, stating any similar exhibits found within the museum, multi-language functionality, share functionality and also a way to state any visited and not yet visited exhibits.

Nathaniel was first required to upload pictures taken at the museum to the Target Manager of Vuforia SDK as to choose the highest recognition rating. Upon completion, research was undertaken to find any information about the exhibits which were selected in the step above. Also was required to find 3D models to present overlaying the scanned exhibit. Upon completion of the above, Speech Synthesizer functionality was implemented to the application to read out the information found.

Jeremy Vella supplied the Database design and added the information found by Nathaniel. Connection tests to the database were done by Jeremy and any code samples where passed on to myself to include in the application. Jeremy also implemented the 'Where Am I' functionality together with all the animations required to show the user his/her location.

We encountered some problems as a team during the coding stage. Each of us had a separate solution and this caused us to lose a lot of time when combining our programs into one. We therefore decided to use a Subversion version control system (Github). This tool manages files and directories, and the changes made to them, over time. This allowed us to commit our changes onto one solution as well as recover older versions of our program or examine the history of how the program changed.

EVALUATION

The method of evaluation was done by observation. There was a total of two candidates who tested out the application at the museum.

The first candidate was an art student studying at the Faculty of Arts. The candidate was chosen because of her frequent attendance of museums as well as having experienced a similar application of augmented reality in one of the museums visited. The experience with the application was a good one. It was discovered that the text of the information was a bit too small to read but the media was satisfying.

The second candidate was chosen due to his experience in UI design as an application designer. It was noted that the application design was very clean and modern looking. The sliding animation to show all visited exhibits was given particular interest. Some suggestions were given as to giving feedback to the user when an exhibit was successfully scanned.

Upon completing the evaluation the following changes were made. A slight vibration was made once the exhibit was scanned as to give the user haptic feedback. Another improvement was in the font size of the text as well as an added link at the bottom of the description which opens the default browser that allows the user to have more information about the exhibit.

CONCLUSION AND FURTHER WORK

Other considerations are to develop this application as a framework and download additional plugins which relate to the museum visited. This way, the application can be used with multiple datasets of multiple museums and still offer the same functionality.

Augmented reality is another step further into the digital age which will help improve both in the development and the scholastic fields. We will no longer be able to discern what is real and what is virtual, which will converge both the digital and physical media.

REFERENCES

[1] BROOKS F.P.: What's Real About Virtual Reality?. IEEE Computer Graphics and Applications 16, 6 (1999), 16–27.

[2] NIELSEN L. B.: Post Disney experience paradigm? Some implications for the development of content to mobile tourist services. ACM International Conference Proceedings Series 10, (2004), 657–666.

[3] FRITZ F.: Enhancing Cultural Tourism Experiences with Augmented Reality Technologies. Association VICOMTech, San Sebastian, (2005).

APPENDIX

The Source Code, APK file and Recognized Images can be downloaded from the following link:

https://drive.google.com/open?id=0B01R61oPDyzocHBJUUFDQ3hNTWM

Installation Guide for Android

Step 1 (Allow Install of Third Party Apps)

Go to Menu > Settings > Security > and check "Unknown Sources"

Step 2 (Google Text-to-speech Engine)

If this is not installed by default on your Android Device, do so by using this link - https://play.google.com/store/apps/details?id=com.google.android.tts&hl=en

Install Application on device, Go to Settings > Language and Input > Text-to-speech > Select Google Text-to-speech engine

Step 3 (Install Application)

Connect Android Device by USB and save APK file to Device

Search for APK using the default File Explorer and Install

ETHICAL REVIEW FORM D

Middlesex University Ethical Review Form D – Amendment

Section 1 – Applicant details

Details of Principal Investigator/Supervisor		
Name:	Department:	
Qualifications:	Email:	Tel:
Name of Student Researcher (if applicable)		
Name: Thomas-Daniel Borg	Programme of study:	
Qualifications: 3rd Year of BSc in Computer Science	Email:TB638@live.mdx.ac.uk	Tel: +356 7980 4854
Details of any co-investigators (if applicable)		
Name: Nathaniel Schembri	Organisation:	Email: NS1098@live.mdx.ac.uk
Name: Jeremy Vella	Organisation:	Email: JV248@live.mdx.ac.uk
Details of External Funding:		

Section 2 – Details of study

Research project title:	**Museum of Fine Arts Augmented Reality Experience**		
Start date	02/Feb/2016	**Proposed end date**	22/Apr/2016
Main aims of the study			
This project aims to allow visitors attending the National Museum of Fine Arts to experience the multifaceted overview of art and artistic expression in Malta in a modern way thanks to this project's Augmented Reality functionality. This is a way of enhancing their visiting experience. Utilizing the Unity framework together with Vuforia SDK, it is guaranteed that all modern media such as 3D models and animations will be presented as to enhance the user's senses			
Details of amendment(s):			
This project will be evaluated on a young Arts student who is currently studying for their B.A in the Faculty of Arts. Having attended many museums, as well as having experienced Augmented Reality in some of them, this student is the ideal candidate. The second candidate was chosen with a difference that this candidate has experience in UI design. This should help us in delivering a somewhat better UI design from the candidate's past experience.			
Are there any **Ethical issues** arising from this amendment? If yes please give details:		**Yes**	**No**

In signing this research ethics declaration I am confirming that the information presented above and in Form A is accurate to the best of r knowledge and belief.

Principal Investigator/Supervisor Signature:

.....

Print name: .....

Date: ..... (dd/mm/yyyy)

Student's signature (if applicable):

.....

Print name: Thomas - Daniel Borg

Date: 3/14/2016 (dd/mm/yyyy)

PARTICIPANT 1

MIDDLESEX UNIVERSITY

GUIDELINES AND TEMPLATES FOR A
PARTICIPANT INFORMATION SHEET (PIS) AND CONSENT FORM

1. Study title
Museum of Fine Arts Augmented Reality Experience – Learning and appreciating local arts in a modern and augmented way.

2. Invitation paragraph
You are being invited to take part in a research study. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

3. What is the purpose of the study?
This project aims to allow Art students who are currently studying for their BA Honors in Arts in a modern and augmented way. Utilizing an application that is installed on a smart device, the camera will recognize any exhibit available in the museum and provide information about the scanned exhibit. Other media will also be available to enhance the user experience of the user.

4. Why have I been chosen?
You have been chosen because of your experience in UI design. This should help us in delivering a somewhat better UI design from the candidate's past experience.

5. Do I have to take part?
It is up to you to decide whether or not to take part. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part, you are still free to withdraw at any time and without giving a reason.

6. What will happen to me if I take part?
A session will take approximately 15-20 minutes. You will be allowed to try out the system with a brief introduction from the researchers. You will be aided if you find any problems whilst the test is taking place. During the test, the researchers will be observing you and taking down notes about your performance. After the test, you will be asked some questions about how you found the project. These will directly influence the project and any changes will be taken place to have better performance.

7. What do I have to do?
You will be instructed as to how the project works. You will be provided with a smart device which has the AR application installed. Once you are in front of the exhibit, you are required to scan the exhibit utilizing the device's camera which will influence the data that is provided for each exhibit with relevant information about said exhibit.
The overall test will take from 15 minutes up to 20 minutes. This might take longer in case you have some problems with running the system. This will then be followed by some questions that we will ask you.

8. What are the alternatives for diagnosis or treatment?
For therapeutic research the participant should be told what other treatments are available.

9. What are the side effects of any treatment received when taking part?

For any new procedure you should explain the possible side effects. If they suffer these or any other symptoms they should report them next time you meet. You should also give them a contact name and number to phone if they become in any way concerned. The name and number of the person to contact in the event of an emergency (if that is different) should also be given.

10. What are the possible disadvantages and risks of taking part?
There are no particular risks when taking on the evaluation test that we will provide. The smartphone is provided by the evaluators with the application installed which therefore does not require you to use your personal device. There is therefore no known risk in participating in this project.

11. What are the possible benefits of taking part?
Since you are an Application Designer, we will benefit from all your past experience in Designing of correct and well done software. Young students will be excited by the fact that they are learning and increasing their skillset whilst playing a game. Ignoring the educational power of games dismisses a potentially valuable learning tool. Augmented Reality in particular, carry enormous potential to draw students into a topic and help them learn information, skill, and new ways of thinking. We hope that participating in the study will help you. However, this cannot be guaranteed. The information we get from this study may help us to treat future participants with unlocking their potential and love for both music and technology.

12. Will my taking part in this study be kept confidential?
All information that is collected about you during the course of the research will be kept strictly confidential. Any information about you which is used will have your name and address removed so that you cannot be recognized from it. All data will be stored, analyzed and reported in compliance with the Data Protection Legislation of the relevant country where the study is being conducted.

13. What will happen to the results of the research study?
The results of the research study will be used in one of the modules leading to an undergraduate course in Computer Science and not for a dissertation. The results will be published on the 22nd of April 2016. If you would like to obtain a copy of the results, please contact Thomas Borg by email 'tb638@live.mdx.ac'.

14. Who has reviewed the study?
The research will be reviewed by the following:
· Middlesex University
· School of Health and Social Sciences
· Health Studies Ethics Sub-Committee.
· National Museum of Fine Arts

15. Contact for further information
If you would like to contact us for any further information, you can do so by contacting the following:
Thomas Borg – Student Researcher
Email – TB638@live.mdx.ac.uk

Nathaniel Schembri – Student Researcher
Email – NS1098@live.mdx.ac.uk

Jeremy Vella – Student Researcher
Email – JV248@live.mdx.ac.uk

Steven Camilleri – Principal Investigator / Supervisor
Tel: 21 456 862

Participant Identification Number: 202389 M

CONSENT FORM

Title of Project: Museum of Fine Arts Augmented Reality Experience

Name of Researcher: Thomas-Daniel Borg; Nathaniel Schembri; Jeremy Vella.

1. I confirm that I have read and understand the information sheet dated 17/032016 for the above study and have had the opportunity to ask questions.
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason.
3. I agree that this form that bears my name and signature may be seen by a designated auditor.
4. I agree that my non-identifiable research data may be stored in National Archives and be used anonymously by others for future research. I am assured that the confidentiality of my data will be upheld through the removal of any personal identifiers.
5. I understand that sections of any of my medical notes may be looked at by responsible individuals from [company name] or from regulatory authorities where it is relevant to my taking part in research. I give permission for these individuals to have access to my records.
6. I understand that my interview may be taped and subsequently transcribed.
7. I agree to take part in the above study.

Joseph Mamo Name of participant	3/17/2016 Date	Signature
Name of person taking consent (if different from researcher)	Date	Signature
Thomas-Daniel Borg Nathaniel Schembri Jeremy Vella Researcher	3/17/2016 Date	Signature

1 copy for participant; 1 copy for researcher;

PARTICIPANT 1 - RESULTS

OVERALL REACTION TO THE SOFTWARE		0	1	2	3	4	5	6	7	8	9		NA
1.	terrible	○	○	○	○	○	○	○	○	◉	○	wonderful	○
2.	difficult	○	○	○	○	○	○	○	○	◉	○	easy	○
3.	frustrating	○	○	○	○	○	○	○	○	◉	○	satisfying	○
4.	inadequate power	○	○	○	○	○	○	○	◉	○	○	adequate power	○
5.	dull	○	○	○	○	○	○	○	○	○	◉	stimulating	○
6.	rigid	○	○	○	○	○	○	○	○	◉	○	flexible	○
SCREEN		**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**		**NA**
7. Reading characters on the screen Information was portrayed effectivley	hard	○	○	○	○	○	○	○	◉	○	○	easy	○
8. Highlighting simplifies task	not at all	○	○	○	○	○	○	○	○	○	○	very much	◉
9. Organization of information Information is clearly labelled	confusing	○	○	○	○	○	○	○	○	◉	○	very clear	○
10. Sequence of screens	confusing	○	○	○	○	○	○	○	○	○	◉	very clear	○
TERMINOLOGY AND SYSTEM INFORMATION		**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**		**NA**
11. Use of terms throughout system	inconsistent	○	○	○	○	○	○	○	○	○	◉	consistent	○
12. Terminology related to task Actions are labelled accordingly	never	○	○	○	○	○	○	○	○	◉	○	always	○
13. Position of messages on screen Position didn't hinder readability	inconsistent	○	○	○	○	○	○	○	○	○	◉	consistent	○
14. Prompts for input	confusing	○	○	○	○	○	○	○	○	◉	○	clear	○
15. Computer informs about its progress While loading a banner is displayed	never	○	○	○	○	○	○	○	○	◉	○	always	○
16. Error messages	unhelpful	○	○	○	○	○	○	○	○	○	○	helpful	◉
LEARNING		**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**		**NA**
17. Learning to operate the system Application was structured to easily oper	difficult	○	○	○	○	○	○	○	○	○	◉	easy	○
18. Exploring new features by trial and error	difficult	○	○	○	○	○	○	○	○	○	◉	easy	○
19. Remembering names and use of commands	difficult	○	○	○	○	○	○	○	○	○	◉	easy	○
20. Performing tasks is straightforward Application was not complex	never	○	○	○	○	○	○	○	○	○	◉	always	○
21. Help messages on the screen	unhelpful	○	○	○	○	○	○	○	○	○	○	helpful	◉
22. Supplemental reference materials	confusing	○	○	○	○	○	○	○	○	○	○	clear	◉
SYSTEM CAPABILITIES		**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**		**NA**
23. System speed Smartphone experienced no lagging	too slow	○	○	○	○	○	○	○	○	○	◉	fast enough	○
24. System reliability No system crashes were encountered	unreliable	○	○	○	○	○	○	○	○	○	◉	reliable	○
25. System tends to be	noisy	○	○	○	○	○	○	○	○	○	◉	quiet	○
26. Correcting your mistakes You can easily backtrack to previous activities	difficult	○	○	○	○	○	○	○	○	○	◉	easy	○
27. Designed for all levels of users Application was very clear and easy to use	never	○	○	○	○	○	○	○	○	○	◉	always	○

List the most **negative** aspect(s):

1. Would integrate some kind of feedback to inform the user that an exhibit has been tracked by the camera
2.
3.

List the most **positive** aspect(s):

1. Simple easy to use User Interface design
2. Informative
3.

PARTICIPANT 2

MIDDLESEX UNIVERSITY

GUIDELINES AND TEMPLATES FOR A PARTICIPANT INFORMATION SHEET (PIS) AND CONSENT FORM

1. Study title
Museum of Fine Arts Augmented Reality Experience – Learning and appreciating local arts in a modern and augmented way.

2. Invitation paragraph

You are being invited to take part in a research study. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

3. What is the purpose of the study?

This project aims to allow Art students who are currently studying for their BA Honors in Arts in a modern and augmented way. Utilizing an application that is installed on a smart device, the camera will recognize any exhibit available in the museum and provide information about the scanned exhibit. Other media will also be available to enhance the user experience of the user.

4. Why have I been chosen?
Since you are currently studying your BA in Arts and Design, having attended many museums, as well as having experienced Augmented Reality in some of them, you were chosen to be an ideal candidate.

5. Do I have to take part?
It is up to you to decide whether or not to take part. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part, you are still free to withdraw at any time and without giving a reason.

6. What will happen to me if I take part?
A session will take approximately 15-20 minutes. You will be allowed to try out the system with a brief introduction from the researchers. You will be aided if you find any problems whilst the test is taking place. During the test, the researchers will be observing you and taking down notes about your performance. After the test, you will be asked some questions about how you found the project. These will directly influence the project and any changes will be taken place to have better performance.

7. What do I have to do?
You will be instructed as to how the project works. You will be provided with a smart device which has the AR application installed. Once you are in front of the exhibit, you are required to scan the exhibit utilizing the device's camera which will influence the data that is provided for each exhibit with relevant information about said exhibit.
The overall test will take from 15 minutes up to 20 minutes. This might take longer in case you have some problems with running the system. This will then be followed by some questions that we will ask you.

8. What are the alternatives for diagnosis or treatment?
For therapeutic research the participant should be told what other treatments are available.

9. What are the side effects of any treatment received when taking part?
For any new procedure you should explain the possible side effects. If they suffer these or any other symptoms they should report them next time you meet. You should also give them a contact name and number to phone if they become in any way concerned. The name and number of the person to contact in the event of an emergency (if that is different) should also be given.

10. What are the possible disadvantages and risks of taking part?
There are no particular risks when taking on the evaluation test that we will provide. The smartphone is provided by the evaluators with the application installed which therefore does not require you to use your personal device. There is therefore no known risk in participating in this project.

11. What are the possible benefits of taking part?
Since you are an Arts student, this project might benefit you in ways as to how you might make certain changes when learning especially for students that are your same age. Young students will be excited by the fact that they are learning and increasing their skillset whilst playing a game. Ignoring the educational power of games dismisses a potentially valuable learning tool. Augmented Reality in particular, carry enormous potential to draw students into a topic and help them learn information, skill, and new ways of thinking. We hope that participating in the study will help you. However, this cannot be guaranteed. The information we get from this study may help us to treat future participants with unlocking their potential and love for both music and technology.

12. Will my taking part in this study be kept confidential?
All information that is collected about you during the course of the research will be kept strictly confidential. Any information about you which is used will have your name and address removed so that you cannot be recognized from it. All data will be stored, analyzed and reported in compliance with the Data Protection Legislation of the relevant country where the study is being conducted.

13. What will happen to the results of the research study?
The results of the research study will be used in one of the modules leading to an undergraduate course in Computer Science and not for a dissertation. The results will be published on the 22nd of April 2016. If you would like to obtain a copy of the results, please contact Thomas Borg by email 'tb638@live.mdx.ac'.

14. Who has reviewed the study?
The research will be reviewed by the following:
· Middlesex University
· School of Health and Social Sciences
· Health Studies Ethics Sub-Committee.
· National Museum of Fine Arts

15. Contact for further information
If you would like to contact us for any further information, you can do so by contacting the following:
Thomas Borg – Student Researcher
Email – TB638@live.mdx.ac.uk

Nathaniel Schembri – Student Researcher
Email – NS1098@live.mdx.ac.uk

Jeremy Vella – Student Researcher
Email – JV248@live.mdx.ac.uk

Steven Camilleri – Principal Investigator / Supervisor
Tel: 21 456 862

Participant Identification Number: 589393 M

CONSENT FORM

Title of Project: Museum of Fine Arts Augmented Reality Experience

Name of Researcher: Thomas-Daniel Borg; Nathaniel Schembri; Jeremy Vella.

1. I confirm that I have read and understand the information sheet dated 17/032016 for the above study and have had the opportunity to ask questions.
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason.
3. I agree that this form that bears my name and signature may be seen by a designated auditor.
4. I agree that my non-identifiable research data may be stored in National Archives and be used anonymously by others for future research. I am assured that the confidentiality of my data will be upheld through the removal of any personal identifiers.
5. I understand that sections of any of my medical notes may be looked at by responsible individuals from [company name] or from regulatory authorities where it is relevant to my taking part in research. I give permission for these individuals to have access to my records.
6. I understand that my interview may be taped and subsequently transcribed.
7. I agree to take part in the above study.

Whitney Grech Name of participant	3/17/2016 Date	 Signature
_____ Name of person taking consent (if different from researcher)	_____ Date	_____ Signature
Thomas-Daniel Borg Nathaniel Schembri Jeremy Vella Researcher	3/17/2016 Date	 Signature

1 copy for participant; 1 copy for researcher;

PARTICIPANT 2 RESULTS

OVERALL REACTION TO THE SOFTWARE		0	1	2	3	4	5	6	7	8	9		NA
1.	terrible	○	○	○	○	○	○	○	○	○	●	wonderful	○
2.	difficult	○	○	○	○	○	○	○	○	○	●	easy	○
3.	frustrating	○	○	○	○	○	○	○	○	●	○	satisfying	○
4.	inadequate power	○	○	○	○	○	○	○	○	○	●	adequate power	○
5.	dull	○	○	○	○	○	○	○	●	○	○	stimulating	○
6.	rigid	○	○	○	○	○	○	○	●	○	○	flexible	○
SCREEN		**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**		**NA**
7. Reading characters on the screen Found it slightly difficult to easily read exhibit information	hard	○	○	○	●	○	○	○	○	○	○	easy	○
8. Highlighting simplifies task	not at all	○	○	○	○	○	○	○	○	○	○	very much	●
9. Organization of information No labels were complex or technically oriented	confusing	○	○	○	○	○	○	○	○	○	○	very clear	●
10. Sequence of screens Menu clearly highlighted application hiera	confusing	○	○	○	○	○	○	○	○	●	○	very clear	○
TERMINOLOGY AND SYSTEM INFORMATION		**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**		**NA**
11. Use of terms throughout system	inconsistent	○	○	○	○	○	○	○	○	●	○	consistent	○
12. Terminology related to task	never	○	○	○	○	○	○	○	○	●	○	always	○
13. Position of messages on screen	inconsistent	○	○	○	○	○	○	○	○	●	○	consistent	○
14. Prompts for input	confusing	○	○	○	○	○	○	○	○	○	●	clear	○
15. Computer informs about its progress	never	○	○	○	○	○	○	○	○	●	○	always	○
16. Error messages	unhelpful	○	○	○	○	○	○	○	○	○	○	helpful	●
LEARNING		**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**		**NA**
17. Learning to operate the system Very easy to run	difficult	○	○	○	○	○	○	○	○	○	●	easy	○
18. Exploring new features by trial and error No action has crashed the system	difficult	○	○	○	○	○	○	○	○	●	○	easy	○
19. Remembering names and use of commands	difficult	○	○	○	○	○	○	○	○	○	●	easy	○
20. Performing tasks is straightforward Buttons clearly labelled	never	○	○	○	○	○	○	○	○	●	○	always	○
21. Help messages on the screen	unhelpful	○	○	○	○	○	○	○	○	○	○	helpful	●
22. Supplemental reference materials	confusing	○	○	○	○	○	○	○	○	○	○	clear	●
SYSTEM CAPABILITIES		**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**		**NA**
23. System speed No issue was noted with system speed	too slow	○	○	○	○	○	○	○	●	○	○	fast enough	○
24. System reliability No system failure was encountered	unreliable	○	○	○	○	○	○	○	○	○	●	reliable	○
25. System tends to be	noisy	○	○	○	○	○	○	○	○	○	●	quiet	○
26. Correcting your mistakes You can easily undo actions	difficult	○	○	○	○	○	○	○	○	●	○	easy	○
27. Designed for all levels of users System was simple enough to be used by all levels	never	○	○	○	○	○	○	○	●	○	○	always	○

List the most **negative** aspect(s):

1. Found the size of the text in the information slightly small, would have found it easier if font was slightly bigger
2.
3.

List the most **positive** aspect(s):

1. High quality features, which are useful in a museum
2. Found application engaging
3.