

An Exploration of Augmented Reality User Interface Design for the Stanley & Audrey Burton Gallery Mobile Application

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Abstract. The main aim of this research is to develop a mobile application that features augmented reality (AR) functions in order to enhance the visitor experience at the Stanley & Audrey Burton Gallery at the University of Leeds. Data for this study were collected using different questionnaire surveys, applying quantitative research methods to the survey results. This study is unable to encompass the entire range of theories concerned with interaction design. The reader should bear in mind that the study is grounded in user-centric principles. It is found that young audiences account for the majority of users who demonstrated positive reactions to augmented reality app technology. This demographic of users pay more attention to the entertainment value offered in interactive interfaces as well as the aesthetics of design. Although such users have not used the gallery's AR app, they have high expectations for this project. Many substantive suggestions are put forward throughout the iterative design process. This research contributes to a deeper understanding of the field of AR as well as human-computer interactions more widely. The findings offer further important contributions to the field of interactive experience.

Keywords: User-centred; Augmented reality; UI Design; Interactive design; Art gallery.

1. Introduction

The purpose of this paper is to describe the design and implementation of a mobile app featuring augmented reality technology, exploring the relationship between user experience and mobile interactive products. There is a growing body of literature that recognises that augmented reality has greatly improved user experience, but the problem persists of how best to enable users to participate in augmented reality interactions more freely. Able to explore opportunities through AR, the creativity of users can be enhanced in order to achieve desired degrees satisfaction (Jessen et al., 2020).

The specific aim of this research is to design an AR App user interface for improving visitor experience at a gallery, describing the design and development of ideas through to the completion of the design process. The existing literature on interaction design is extensive, and the bibliography for this research focuses particularly on user experience and AR.

In recent years, there has been more research on AR in the field of interaction design, opening up new marketing strategies (Rauschnabel et al., 2019). The popularity of the mobile game "Pokémon Go" is a successful case of AR entering the public's field of vision. The reasons for its popularity include users' ability to experience virtual creatures projected in the real world for the first-time, akin to hunting treasure (Rauschnabel et al., 2017). Regarding other examples, Beck and Crié's (2018) research suggests that AR is also used in virtual fitting rooms, proving a further advancement in marketing for the e-commerce industry (Rese et al., 2014). Not only this, but AR has also penetrated the home furnishing industry, providing users with the function of testing and trying out furniture online. In the beauty industry, L'Oréal have introduced the concept of "beauty technology", where users can explore virtual makeup (Bona et al., 2018). Together, these studies indicate that AR has gradually become a mainstream trend in the improvement of user experience, with the demand for it only likely to increase in the future.

The use of AR for gallery apps can be observed in many institutions; this research is not fielding a brand-new innovation but instead provides new insights between the fields of art and technology, reflecting a wealth of ideas from previous studies. The direct beneficiaries of this project are design

industry enthusiasts, art curators, and teachers and students at the University of Leeds. With this, the research contributes to a deeper understanding of interactive art technologies.

2. Problem identification

2.1. Focus Group

2.1.1 Participants

Several participants were asked in the focus group, and some questions about the daily operation of the gallery were answered by the gallery staff. The methodological parameters do not distinguish participants according to gender, age and nationality.

2.1.2. Procedure and materials

The first steps to this process include outlining relevant questions and recruiting participants. Before data collection, ethical permission and signatures confirming participants' consent were attained. Following a structured process, the host conducted an 8-minute opening, introducing the background of the seminar, the rules to be followed, and asking team members to introduce themselves. The seminar was divided into two parts. The first part was a 50-minute formal question session, including a 10-minute general question and answer section surrounding the gallery and AR. Following this was an in-depth 40-minute discussion. The second part was a 10-minute review and summary of the previous discussion, in which members set up a closing question and supplementary questions.

2.1.3. Results

Results show that participants did not take the initiative to learn about the gallery themselves, being mostly informed by recommendations from friends or mentors. There are some problems in the gallery, such as the lack of an obvious guide system, the single exhibition format, and the fixed content, which are all factors detracting from visitor experience. Visitors expressed that they are more interested in novel exhibitions, so they look forward to this project.

2.2. Questionnaire

2.2.1. Participants

A short questionnaire was designed to ascertain the participants' visiting habits and preferences. 54 participants participated in the survey. Part of them in the response through the online questionnaire and the other part was the data obtained by inviting visitors to participate in the survey in the offline exhibition hall. The opening three questions were designed to record the gender, age, and occupation of the group.

2.2.2. Procedure and materials

The author participated in the research, and team members worked with the author to complete the questionnaire design and distribution. The setting of the question is mainly intended to measure visitors' experiences of the gallery and their familiarity with AR. The results of the questionnaire were obtained through two channels. The first was published on the college's social network community, including chat groups, Facebook, and public mail. In addition, we also conducted offline questionnaire surveys with audiences who were visiting the gallery. Among them, in the afternoon on March 6th, the author and team members invited visitors to answer the questionnaire on the spot in the exhibition hall. A total of 20 answers were collected. Working in the field such as this can generate better responses, grounded in a participant's perception of their current experience.

2.2.3. Results

The statistical results are shown in Fig 1. Most respondents were female art students, in the age of group of 18-25, account for most of the visitors. Art or design students have a regular habit of participating in exhibitions. They have a higher aesthetic appreciation for art and have a professional

vision. Therefore, these participants are more able to notice the shortcomings of a gallery in terms of works, facilities, and the overall environment. Many put forward suggestions worth considering.

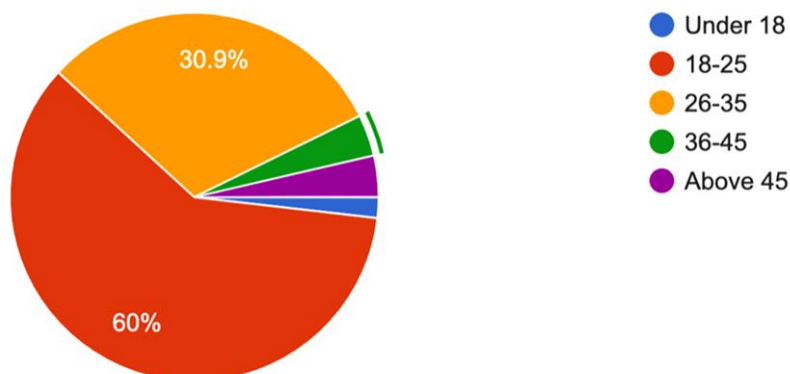


Fig 1. Age distribution chart

Based on the results of the questionnaire survey, the following areas of improvement are suggested:
Strengthen the interaction between visitors and artworks.

The exhibition format should be more diverse.

Further written interpretations about the object should be given as well as just seeing the artist's name.

Navigation equipment or a map should be created for users to better understand the facilities.

More interesting features are required to attract more visitors.

2.3. Interview

2.3.1. Participants

Participants for the interview consisted of 8 visitors and 1 staff member. The interview questions of staff focused on gallery operations, and their answer sources were more official and worthy of reference. The visitors were all students from China and the UK. In terms of gender distribution, only one visitor was a male student. What needs to be admitted is that the sample size of this study is inadequate and lacks representativeness, and the research data is only obtained within a limited range. The subjects of the interview covered four major categories: design, history, science, and law.

2.3.2. Procedure and materials

Before the interview, different question outlines were designed for visitors and staff. The interview research method was intended for asking more in-depth questions. The direction of the questions in the outline was divided into several parts: personal information, how to find the gallery (For visitors)? / about gallery daily traffic and average visit time (For staff). The purpose of their visit, the current problems in the gallery, and the audience's impression and understanding of AR were also discussed. These baseline questions extended to further questions, with the researcher responsible for recording and structuring the interview.

2.3.3. Results

The results of the interviews are shown in Fig 2. The interviewees were quite willing to participate in this project, and they were eager for the gallery to develop AR functionality. Similarly to the previous survey results from the questionnaire, most people agree upon the reasons for visiting the gallery as well as its existing problems. They suggested that the gallery's facilities need to be updated and it is important to add some new features in order to attract more visitors. The consensus amongst people suggests that the problems are widespread and require changing.

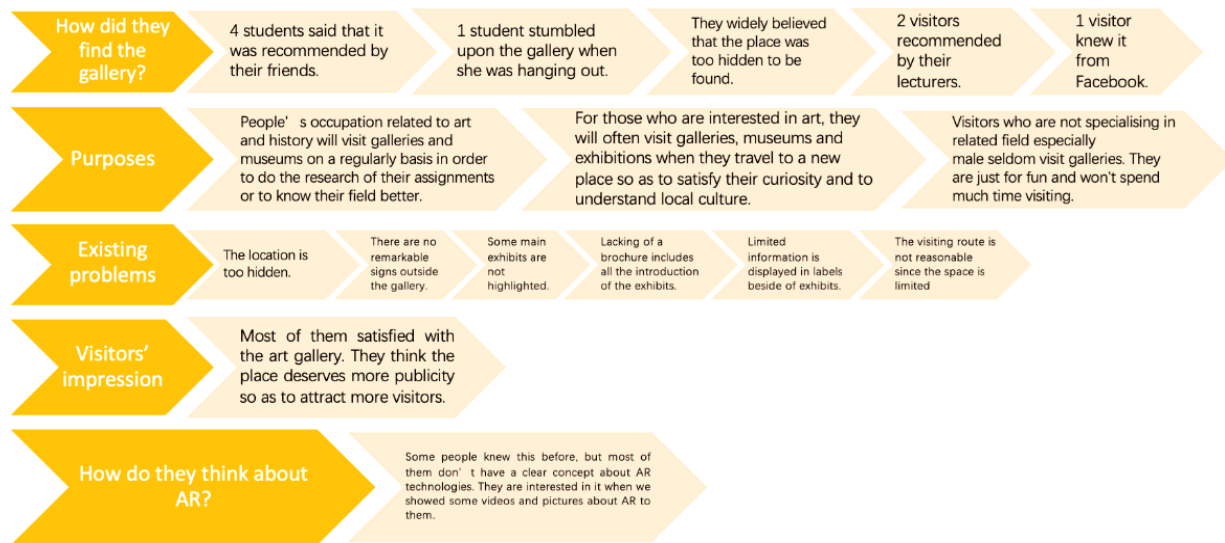


Fig 2. The responses of the interview.

2.4. Observation

2.4.1. Participants

The target audience of the observation team were all visitors. During the 11-day observation, data for 33 visitors was recorded in Fig 3. The observations include gender and age group, as well as the time and frequency of visitors staying in different locations in the exhibition hall. The most important observation was of the interactive behaviours that people perform while viewing the exhibition.

Gender Distribution of Visitors

A total of 33 visitors were collected, there are 10 males and 23 females. It is obvious that females are the majority.

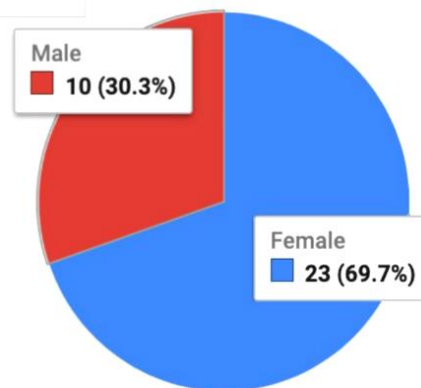


Fig 3. Composition of participants

2.4.2. Procedure and materials

Before making observations, the team members developed an understanding of the gallery. It was worth learning that the observation team did a static survey in the early stages. They inspected staff in terms of behaviour, emotion, and professionalism, also analysing the value of the various facilities in the exhibition hall. The layout and interaction points of the works in the exhibition hall are presented in the plan. After these steps, formal observation were made. The actual result of the observation is currently displayed in Table 1.

3. Design solution and development

3.1. Rationale for design solution

To carry out the iterative design that attends to the above problems, it is necessary to refer to design principles that help designers explore problems and propose solutions. All the content included in the design process is grounded in the design principles, as long as these sources are traceable (Lee, 1997).

Firstly, solutions focussed on applying appropriate design concepts that guaranteed that the needs of users were taken into account. Here, the author aims to solve these problems through two iterations. Users should be allowed a wider choice, across three different design concepts that are displayed as a complete prototype interface. AR is the focus of this project. Therefore, the design mainly focusses on the use of AR in the gallery. The following three functions are expected to be added to AR:

When the user uses the AR function in the app to scan the work accessed via a touchpoint in the gallery, they can see a 3D visual image/motion graphics of the object.

To solve the lacking interpretation of works in the gallery, users can scan the work to obtain detailed relevant information.

The user can scan the work and click on the "audio" mode to switch to voice commentary.

The gallery will regularly hold sketching activities. Aimed at the club's painting lovers, turning on the AR sketch function can generate line drafts and colour schemes of works for this group to aid them in copying and practicing.

The three design schemes are based on this, adding basic functions of the gallery app, including the promotion of exhibitions and event information - which solves the problem of information lag as caused by insufficient publicity mentioned by users). The app also includes all the gallery's artworks, not limited to the exhibition halls, including public art throughout the entire Leeds University campus, making them available online for people who cannot visit the site.

In addition to functional design, the author considered the aesthetics of the personalised design of the user interface, because a good aesthetic determines the user's first feeling of using the product. This requires designers to understand the factors that impact user experience and aesthetic preferences. Therefore, current design trends are integrated into the three design concepts to balance functionality and aesthetics, whilst also solving the problems raised by users.

3.2. Guidelines from the literature

Some scholars have discussed the design of interactive experiences and user interfaces. Bill (2007) proposed that although interactive design ultimately creates a physical model that can be used by people, following human-oriented concepts, the ultimate goal of design is to facilitate optimal user experience rather than produce a product itself. The physical object is the vehicle that delivers the function and vision of the design. The balance between the function and aesthetics to be considered. If the design is only concerned with the aesthetics of an interface, the final product will be little more than an over-decorated frame; on the contrary, if the functionality is particularly prominent, the user will lose interest in repeated operations that are void of style and representational impact. This view confirms the author's thinking surrounding the design solutions. Although the results of this research shed light on the balance between interaction and experience, they are limited to daily common example and are not reflective of a specific interaction prototype. Moreover, this article is too short to wholly represent the research field of interest; the writing is more so intended as a subjective account of a particular design process.

The UI design process involved in this project demands guidance and references. The degree of attention focussed on UI design methods has increased substantially in academia. In order to provide designers with guidance, McInerney and Sobiesiak (2000) provided several different design process solutions:

Method 1: First of all, McInerney and Sobiesiak proposed that every iteration of a design needs to provide a solution in the user interface. Such design works as a guide, allowing designers to make

changes on the basis of advanced work, evaluate and modify this work further, and finally complete the process in the creation of a prototype.

Method 2: The more traditional design process follows preliminary research and the analysis of results; this is preceded by conceptual design, the realisation and testing of prototypes, towards a final evaluation.

Although these methods are different, they both ensure satisfactory feedback for the designers involved. In short, these studies have emphasised that using correct methods during the development of user interfaces can help avoid errors, simplify the workload, and make the entire design process more organised. This is a necessary reference source for beginner in interactive design. In the creation of the gallery app, the author followed the steps recounted in Method 2. This choice is conservative, but helps avoid major errors. The main weakness of this approach is that it only provides a methodology and does not give any suggestions from a visual perspective on interface design. It seems that the content of their argument is a bit thin and cannot provide a complete project guideline.

When reviewing the literature, the author paid special attention to mobile design projects that combined with augmented reality. Law (2018) participated in the design of the application program for the archaeological site in England and puts forward many views that coincide with this project. Her project was aimed at encouraging cultural heritage tourism in Thetford Priory, enhancing visitor experience with the development of a mobile application that used geographic location-related augmented reality. This is consistent with the goals pursued by this project. Law (2018) proposed that the design of the application needed to consider how to reduce the difficulties of its usage, highlighting the simplicity of its functions. As an additional attraction for the public at sightseeing spots, the app had to be accessible to all ages. The difference between this previous and the present project centres on the museum's use of QR codes as scanning contact points, while the gallery instead pushes for users to interact more directly with the work itself. Law's research also took the form of a short questionnaire survey. The limitations of previous questionnaire research are the same as those encountered in her research. The quantitative research method is relatively limited, and detailed descriptions and psychological activities of the participants was not obtained, impacting the designer's judgment to a certain extent.

3.3. Iteration 1

3.3.1. Participants

24 participants filled out a questionnaire centred on opinions and choices surrounding the application design. Among them, Chinese students majoring in design and fine art at the University of Leeds accounted for the majority, and the age group was concentrated to 18-24 years old. The questionnaire was sent from social platforms and emails, and 24 valid responses were received.

3.3.2. Procedure and materials

The questionnaire surrounding design concepts, distributed via Google Forms, was divided into four parts. Part of the survey questions in each section recorded responses according to a 5-point Likert scale. These questions asked participants to rate how strongly they agreed with the design from the perspective of attractiveness, usefulness, and their favourite aspects. Each part also included a subjective question, asking participants to put forward suggestions for improvements of this concept. The three design concepts were divided into three distinct parts with related questions. The last part of the questionnaire required users to choose one of the three concepts as their favourite, asking for their reasons and suggestions.

3.3.3. Results

According to data from the survey results shown in Fig 4, when voting for which concept they considered worthy of in-depth design, 14 of the 24 participants selected Concept 3. The overall rating for Concept 3 was relatively high. It can be seen from the feedback that users are attracted to the particular design style, featuring strong visual impact and colour blocking. However, the limitations

surrounding this concept include the forfeiting of usability to excessive aesthetic appeal. The intended function of the design, to effectively convey information, should be a priority.

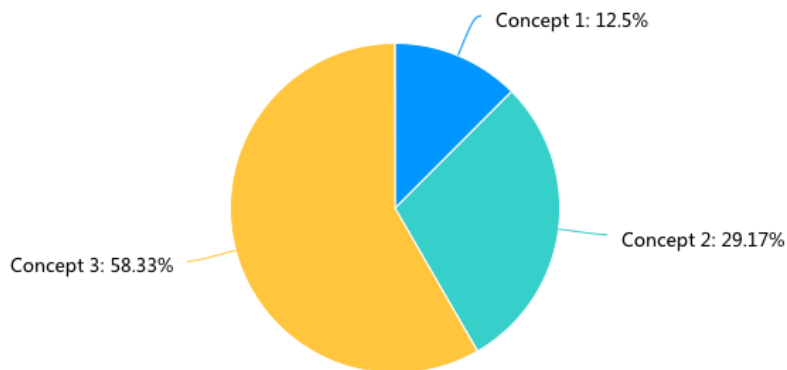


Fig 4. Concept choice.

3.4. Iteration 2

3.4.1. Participants

Twenty participants filled-out a usability test questionnaire. The questionnaire was published on an online platform. To seek a wide range of suggestions, the author does not distribute the questionnaire to the designated users and is not subject to any conditions. It is only posted on the social platform for users to participate in the answer randomly. Questions about gender, degree, and age were not collected in the questionnaire, because the related facilities of this gallery benefit all visitors.

3.4.2. Procedure and materials

Based on user feedback and user-centred principles, Concept Three is selected for further revision in Fig 5 and Fig 6. Compared with the previous design drafts, a more functional design is detailed. According to the consistency of interaction principles, the choices surrounding colour matching are more unified, the font selection has been made more targeted, and the card-like layout delivers the concise and consistent style of the interface. The design displays the content against a dark background. To facilitate with usability testing, a digital prototype was created for users to simulate their experience.



Fig 5. Concept 3 development.

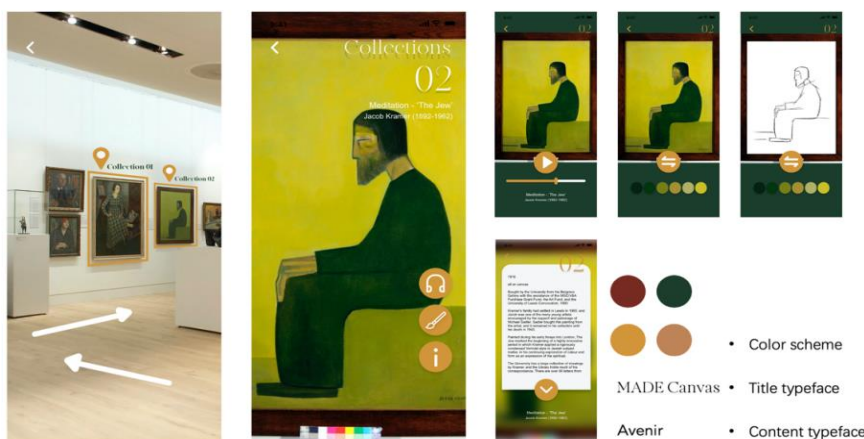


Fig 6. Concept 3 AR pages.

3.4.3. Results

Part of survey questions at this stage utilised a 5-point Likert scale. The questions asked participants to rate how strongly they agreed with each statement. After each 5-point Likert scale question, there was a subjective question asking the user to explain the reason for the score. The first question was used to determine the user's overall impression of the design prototype. 15 participants gave a 4-point evaluation. They gave reasons including that the design combined minimalism and functionality. In the 1 to 5 scale, 1 means strongly disagree, 5 means strongly agree, and 2 to 4 mean disagree, neutral and agree respectively. most users' evaluations are concentrated in agreeing and strongly agreeing.

All in all, the redesigned prototype was tested, and users demonstrated their satisfaction with the layout and colour of the app. Many suggested that the design is creative and practical, whilst the interface is widely accessible. Some different opinions still need to be taken into consideration:

One user argued that the eye icon representing 'AR' after the test was confusing, and that the meaning of 'AR' required further explanation.

Although visual impact in terms of colour was very strong, the background colour was too dark, making the text difficult to read.

The ratio of images and texts needs reconsidering.

AR navigation functions need to be improved.

The font of some titles is inappropriate.

Table 3. Suggestions from participants

The color is charming	Sorry I don't understand layout	When I go to the art museum, I rarely use the introduction of painting	It is very clear to search information	good
The white font is not very clear visually	Excellent way	Highlight the key points, mainly highlight the oil painting.	it might be difficult to link AR function and the eye icon	Multi-language version
The color is comfortable, each section looks clear and the typeface is easy to read.	It's very easy to find each category.	Why so many questions? I just like it	Sometimes people don't know the eye button means AR when there is no text description.	It would be nice if there were some improvement in the font
The app combines minimalist style and functionality	It's normal app content	Can add some social functions.	It just cannot I even don't know there is a AR button	The font in the bottom of the specific 'Collection' page are thin and a little bit hard to read.
The balance of the color makes me feel good.	Convinced to look through the art pieces.	It's useful and convenient.	I did'n realise the eye icon was the AR. I thought it was the home page where I am located.	Navigation needs to be improved
Match color and stable accord with thematic characteristic.	There are some good stereo effects	Easy to use	The proportion of picture and text could be better.	Color is a little bit dark
I like the main color very much.	Can add more category.	Some icons are not clear.	good	You can find a more attractive photo on the cover of the app

All suggestions from Table 3 for modification are adopted purposefully in the final design evaluation stage.

4. Evaluation

4.1. Participants

27 participants completed the final questionnaire for the app prototype test. Among them, five were male and 22 were female. There were 16 participants in the age group of 18 to 24, 10 between the ages of 25 to 31, and only one respondent was over 40. Respondents had different backgrounds. Among them, 21 were students in school, 6 from art-related majors, and 6 were professionals with formal jobs. Since differing nationalities was not an influencing factor for the design prototype, the nationality of participants were not investigated in the questionnaire. All participants cooperated in the design of interactive prototypes when participating in the survey.

4.2. Procedure and materials

The prototype was created to be an effective technique for testing problems and verifying usability (Benyon et al., 1994). The interactive prototype was redesigned on an iterative basis and then added to the usability test questionnaire. Gould and Lewis (1983) and Gould et al. (1997) argued that usability testing is necessary in the development process to achieve the best results. In contrast to previous studies, this assessment is based on five goal-oriented small tasks that invited participants to give suggestions when using the interactive prototype. The content of the questionnaire was divided into the following 7 sections:

Background: Statistics on the gender, age, and occupation of participants was gathered. The frequency of visits to the Stanley & Audrey Burton Gallery and the reasons for their visit were also covered in the scope of the questions. To better understand user preferences, the author also included questions about what kind of art forms visitors most appreciate in the gallery. The last but most important question asked audiences how much they rely on text guides or audio guides to learn more about artworks. The questions in the first section consisted of single choice, multiple-choice, fill-in-the-blank, and 5-point Likert scale questions.

Tasks one to five: 5 tasks in Fig 7 were divided into sections that asked questions, linking back to the design prototype at the beginning of each task. Each section had 3 to 4 questions, including one subjective fill-in, whilst the rest use a 5-point Likert scale to measure the degrees of users' approval. A task board investigation tests the rationality of the design prototype, which is the most direct way for users to observe problems. For example, users were asked to find the deadline of the current exhibition using the app, filling in the answer by using the interactive prototype. Each section used the same kind of question, asking participants to find the name of a painter of a certain painting through AR functions. Users were guided through more pages in the process of searching for answers, allowing them to observe where the defects of the prototype are. After the users filled in the answer to the subjective question, a 5-point Likert scale provided questions regarding usability.

Task one

Using the prototype, write below the answer to check the exhibition details of "The Expressive Mark".
<https://xd.adobe.com/view/e9a42a68-4aee-4403-4439-3736a0bbf6e2-9f95/?fullscreen&hints=off>

Task two

Using the prototype, write below the answer to find the colour scheme of "Portrait of Nina Hamnett" by using the AR function.
<https://xd.adobe.com/view/e9a42a68-4aee-4403-4439-3736a0bbf6e2-9f95/?fullscreen&hints=off>

Task three

Using the prototype, write below the answer to find your current location in the exhibit hall.
<https://xd.adobe.com/view/e9a42a68-4aee-4403-4439-3736a0bbf6e2-9f95/?fullscreen&hints=off>

Task four

Using the prototype, write below the answer to browse through all the paintings in the gallery and find the painting "Kitchen".
<https://xd.adobe.com/view/e9a42a68-4aee-4403-4439-3736a0bbf6e2-9f95/?fullscreen&hints=off>

Task five

Using the prototype, write below the answer to activate the AR function for the "Portrait of Nina Hamnett" and access the sketch feature.
<https://xd.adobe.com/view/e9a42a68-4aee-4403-4439-3736a0bbf6e2-9f95/?fullscreen&hints=off>

Fig 7. Task module.

Overall evaluation: After a series of clue-finding sessions, users' familiarity with the app improved. In the last sections, questions asked about the overall design, operational difficulty, visual design, and user experience. The questions asked participants to rate how strongly they agreed with each statement. In the end, the author asked participants to recommend a gallery app they liked as a design reference, asking users to outline their favourite features of these other apps. There was a subjective fill-in-the-blank question for participants to leave any suggestions that they felt might further improve the design.

4.3. Results

Background: 11 participants claims they visited the gallery several times a year, and 7 people suggested they visited at least every three months. The remaining participants, except for 5 participants who had never been before, visited more frequently. The most common reason for visiting the gallery is the personal interest of art lovers. Regarding the choice of art forms in Fig 8 that users most liked to visit (multiple choices), paintings and photography were ranked first, followed by installation and experimental art. From this analysis, younger groups are indeed more inclined to visit trendy art forms. Twenty visitors agreed or strongly agreed that they relied on text and audio guides.

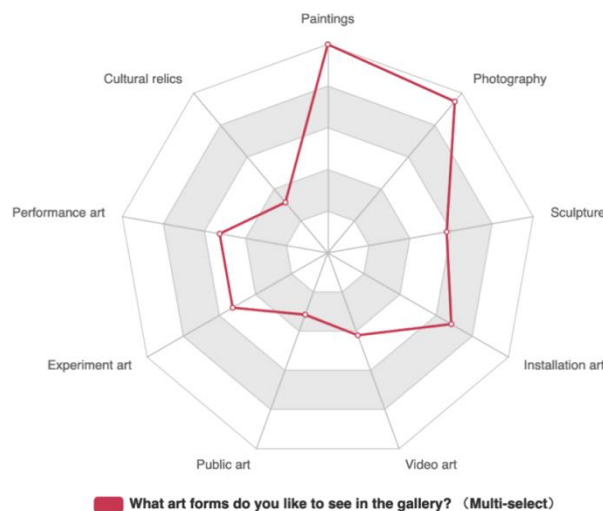


Fig 8. Survey of audience preference for exhibition format

Tasks one to five:

Task 1 required participants to use the prototype to find the final day of the exhibition, "The Expressive Mark". 14 people found the correct answer, and 21 people thought the information was easy to find shown in Fig 9.

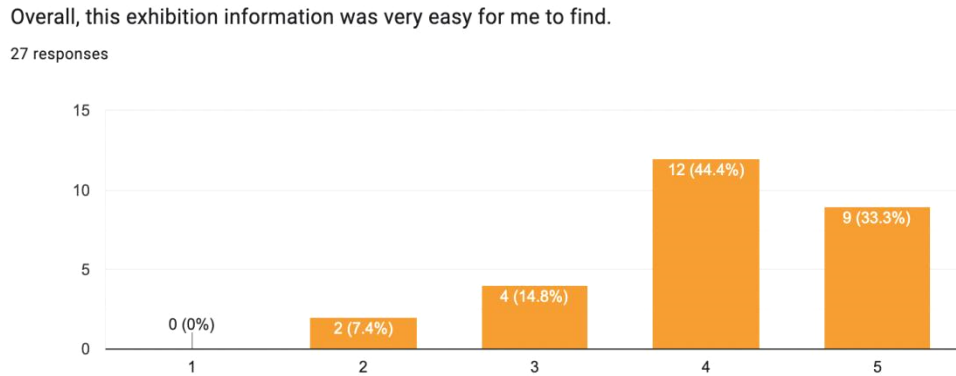


Fig 9. Participants' response to task one.

Task 2 required users to utilise AR functions in the prototype to find the colour scheme of "Portrait of Nina Hamnett". 18 people found the correct answer through testing. More than half of the people thought this function was easy to use and interesting.

Task 3 required using the AR function page in the prototype to find and describe the current location of the exhibition hall. 22 users gave answers that were close to expectations. They thought that although it was a little hard to find, this feature is necessary for the gallery.

Task 4 requires the user to browse the "Highlights" in the prototype, finding and filling-in the painter of "Kitchen". 23 users filled in the correct answers, and more than half of them were satisfied with the visual design of the "Highlights" part.

Task 5 required the user to generate a sketch of "Portrait of Nina Hamnett" through the AR function in the prototype. 10 participants thought that the difficulty of the operation was at a medium coefficient, whilst 2 participants thought it was more difficult to find. Overall, everyone agreed that this feature was very helpful for those who like to sketch in the gallery.

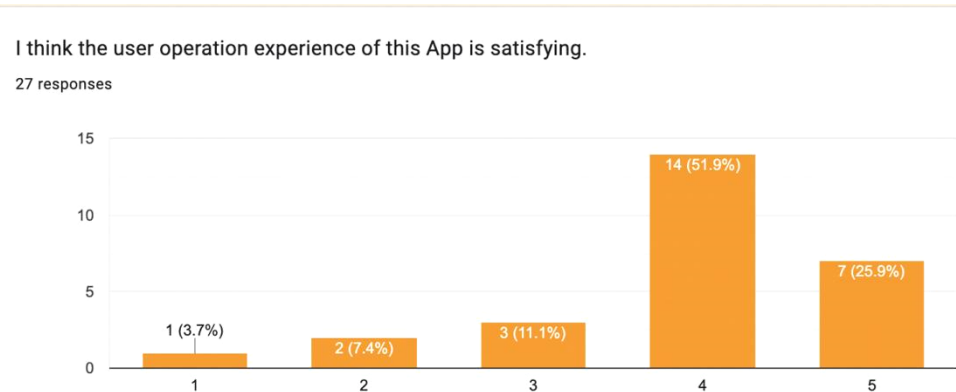


Fig 10. Overall satisfaction.

Overall evaluation: In general, participants gave a high evaluation of this app in Fig 10. 25 users were satisfied with the overall visual design; 22 users thought that the operating experience was simple, and the choice of colour and font were satisfactory in terms of conveying information. Some users recommend the Tate Museum app as a reference. When users selected their favourite functions of the app, the "Highlights", "AR Navigation", and "Background Introduction of Works" were most popular. The following is a list of operable amendments provided by users in Table 4:

Table 4. Final suggestions from participants.

Any suggestions to help this design get better?				
Regarding the author name of kitchen, I need to pick up pictures one by one	It looks good, simple and artsy, I like it.	It's har to find the sketch.	It's hard to find the colour scheme of the painting.	the navigation function can be better.
You can add the artworks name in the paintings interface; Events section in the menu maybe takes too big; Exhibitions title can make it more obvious. Map function icon can change. Sketch function can simplify.	Maybe you can add the painting's name below the painting, because I don't know the painting's name before I click it. And some shortcut might benefit the operation process.	The painting section looks confuse. Make it more orderly.	perfect	make it real, especially AR.
Simple style, it's easy to operate.	The interpretation of artwork is limited	Very complete, clear function guide	Icon with text operation may be smoother	The blank area is too large

The interface design of the entire APP has changed a lot shown in Fig 11 from the original concept. To keep the design consistent, the author moved all the visual elements of the interface to the official logo of the launch page, extracted the visual elements of the logo, and used it in the colour matching of the entire interface. The author of the original idea focused on the individualization of the product, aiming to show visual impact, but lacked the connection with the elements of the gallery. In the final output, a large area of white is used as the main colour, and the logo colour is used as an auxiliary colour to reduce unnecessary colour blocks and simplify the style. It mainly highlights the information of the gallery's works and plays a role in setting off the artworks.

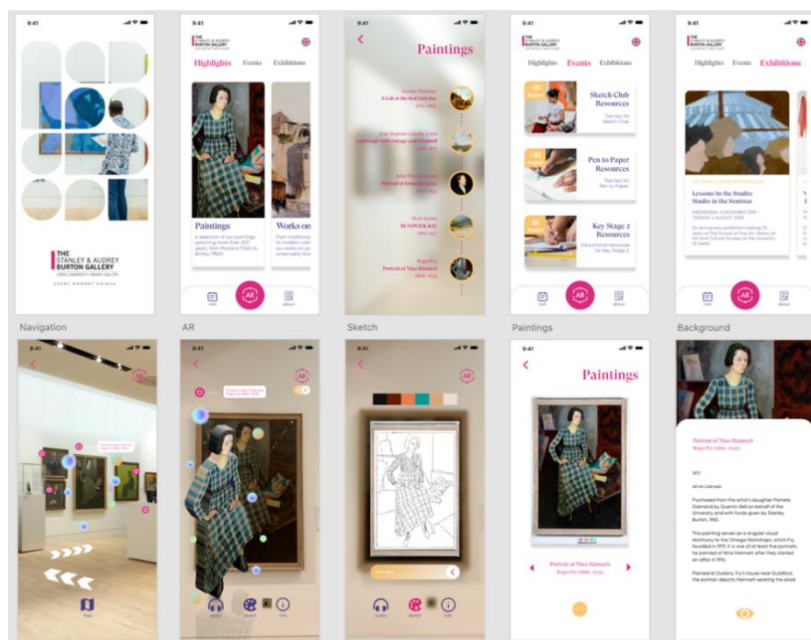


Fig 11. Final outcome

5. Conclusion

The main purpose of this paper was to improve visitor experience by designing an augmented reality mobile application for a gallery. The results of the study show from users' evaluations that the prototype is satisfactory. Participants showed a high degree of interest in the simple usability and enhanced user experience, meeting the goals of this project. One unanticipated finding goes against the original assumption that is reasonable to only use icons to guide the users through the app, in turn making each page more concise. However, users mentioned that icons without text explanations were confusing. Everyone has different opinions on the interpretation of icons, which causes difficulties in finding relevant information.

Although this discovery is preliminary, its significance lies in the fact that users participated in this project with focus, producing successful test. These results match the data observed in earlier studies and further reflects the design methods advocated for by McInerney and Sobiesiak (2000).

The current results are meaningful at least in terms of identifying new problems and solving some of the initial problems encountered by previous research. The feedback obtained through testing shows that this design is efficient and may stimulate the views of gallery managers toward implementing AR app technology.

Nonetheless, the findings of this project are accompanied by the following limitations. Usability testing is a complex interdisciplinary collaboration. There should be a professional who understands human-computer interaction to participate in development, performing specialist duties with UI designers (Gulliksen et al., 2002). This project was completed by only one author, so the test results remain at a simple level. The disadvantage of quantitative research lies in the fact that the collected data is more superficial, the explanation of phenomenon is weak, and the test sample size and diversity need expanding.

Other researchers should focus on interactive programming in the future. A lack of experience in coding is a common problem that user interface designers need to solve (Gulliksen et al., 2002). The implementation of augmented reality technology is the most significant facet of this project. Based on the promising findings presented in this paper, work on the remaining issues continues into future research.

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