

Designing Mobile Augmented Reality Art Applications: Addressing the Views of the Galleries and the Artists

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ABSTRACT

The utilization of mobile augmented reality to display gallery artworks or museum content in novel ways is a well-established concept in the augmented reality research community. However, the focus of these systems is generally technologically driven or only addresses the end user and not the views of the gallery or the original artist. In this paper we discuss the design and development of the mobile application ‘Taking the Artwork Home’, which allows people to digitally curate their own augmented reality art exhibitions in their own homes by digitally ‘replacing’ the pictures they have on their walls with content from the Peter Scott Gallery in Lancaster. In particular, we present the insights gained from a research through design methodology that allowed us to consider how the views of the gallery and artists impacted on the system design and therefore the user experience. Thus the final artifact is the result of an iterative evaluation process with over 100 users representing a broad range of demographics and continues to be evaluated/enhanced by observing its operation ‘in the wild’. Further, we consider the effect the project has had on gallery practices to enable both augmented reality designers, and galleries and museums to maximize the potential application of the technology when working together on such projects.

Categories and Subject Descriptors

H.5 Information Interfaces and Presentation.

General Terms

Design.

Keywords

augmented reality, mobile, art, design, research through design.

1. INTRODUCTION

The augmented reality research literature has traditionally divided mobile augmented reality (MAR) into either handheld or wearable

devices, although given the ubiquity of mobile technologies this is arguably changing to a division between mobile and wearable in-line with other computing fields that no longer use the term handheld. In the paper we are using MAR specifically in relation to phones and tablets in recognition of the current dominance of these devices as a platform for the development of AR systems.

MAR has generally been viewed as more practical for wide-scale adoption than wearable AR as commercial mobile phones are so widespread and Head Mounted Displays (HMD) have often been criticized for limiting the field of view, providing poor comfort, and even inducing motion sickness [12]. Despite proliferation of MAR implementations, the recent launch by Google of Glass means we do not yet know whether wearable’s may ultimately win out over phones and tablets.

Within MAR there can be significant differences in the implementation, and consequently the operation, of these services arising from the method they use to estimate the position and orientation of the camera (pose) in relation to the scene being viewed. The approaches for estimating pose can be divided into sensor or vision-based. Sensor-based approaches take advantage of increasing numbers of sensors such as Global Positioning System (GPS), accelerometers, magnetometers (digital compass), and recently gyroscopes on mobile phones. Combining the outputs obtained from such sensors allows the camera pose to be estimated [17] in relation to three-dimensional (3D) space. Although such systems are relatively easy to implement, the main issue is that the use of GPS limits the applicability of this approach to cultural sites outdoors. This is because GPS accuracy can be highly variable due to spatial scattering that will ultimately impact on the contextual sensitivity of any applications developed.

While the simplest of vision techniques involve the use of two-dimensional (2D) fiducial markers to provide a pose estimate [18], the practicalities of covering museums and galleries with such markers limits the situations in which it can be realistically deployed. In terms of non-fiducial marker tracking, many of the mobile implementations utilize an optimized version of Scale-invariant feature transform (SIFT) algorithm to effectively allow any suitable image to become a marker [19, 11], which is arguably a more attractive option for galleries and museums, as they would be less obtrusive. In relation to this project, user defined markers [7] are particularly relevant as they allow users to engage with an application without necessarily using pre-defined markers. In this particular project we encourage the use of pictures they may currently have on their walls of their own

homesas markers that can then be ‘replaced’ with gallery content using the app.

Although natural feature tracking and scene reconstruction is starting to emerge [9, 2] there is some way to go in adapting these techniques so that they can be easily implemented on current phones and tablets. Even though these maps are generated in real time they continue to be limited to static environments, a constraint which is bound to persist until alternative methods of reconstruction emerge, or depth cameras become available on handheld devices [4]. Note that the emergence of Google’s project Tango may well be the start of the emergence of such devices. The flexibility of augmenting non-planar dynamic environments would no doubt benefit museums and galleries, as they often adapt their space to accommodate the varying needs of particular exhibitions.

AR has been used in a variety of ways within the cultural sector predominantly in terms of guides for cultural sites [13, 3, 15, 14] or to provide alternate representations of the museum content or additional meta-data [20, 1]. In relation to paintings and photographs, to which the application presented is currently focused, then AR has been used both to view artworks [8], create artworks [6], and even provide alternate infrared or ultra-violet [8, 16] views of the painting.

In this paper the MAR application under consideration is not designed to operate within the existing physical gallery but rather it allows users to engage with the gallery content in their own home by using the current pictures on their walls as user defined markers. It builds on existing work by the Peter Scott Gallery aimed at encouraging public engagement with more of the gallery’s collection that may be on show at a given time. The aim is that by providing an experience of viewing artwork that is situated in a physical space, is that it most closely resembles what a user might experience in a real gallery, in that they can view from various angles of focus on specific elements. While it is hoped that this experience encourages users to consider visiting the physical gallery, the data generated by users engaging with the collection will also provide valuable insights in what aspects of the collection people find interesting and how they curate and combine particular artworks. Ultimately this data might suggest new themes for exhibitions that we could curate within the physical gallery that might attract a wider audience. In the forthcoming sections we focus on: how the views of the gallery and the artists impacted on the system design and therefore the user experience; the effect the project has had on gallery practices.

2. DESIGN

This is a research project based on a partnership between the gallery, design researchers, and a technology provider with a remit (beyond the creation of this digital artefact) of providing more general insights for arts organizations considering the use of augmented reality. Thus, this project deliberately uses commercial hardware and software libraries to create a compelling user experience that could be re-created by a variety of cultural organizations. However, we have achieved this while adopting the principle first espoused by designer Raymond Loewy of creating the Most Advanced Yet Acceptable (MAYA) solution. Therefore the design seeks to use the most advanced aspects of commercial AR libraries while making it acceptable to not only the users but also the gallery and the artists. In relation to users Loewy derived his principle from his belief that [10]:

“the adult public’s taste is not necessarily ready to accept the logical solutions to their requirements if the solution implies too vast a departure from what they have been conditioned into accepting as the norm.”

This view seems very applicable when considering the current state of public understanding of AR as we encountered very few people during our evaluations that had ever experienced AR and of those that had, the vast majority had only experienced sensor-based systems such as Layar or Wikitude ([//www.layar.com](http://www.layar.com), [//www.wikitude.com](http://www.wikitude.com)).

Therefore the system was developed using a research through design methodology [5] with over 100 people using an iterative participatory design approach whereby a number of prototypes were presented to a range of potential user groups of between 8-20 people for feedback and discussion as illustrated in Figure 1. These groups included volunteers and patrons of the gallery, children from local schools varying in age 6-18, and a local college that provides courses for learners between 18 and 25 with a broad range of physical and learning disabilities. Within these sessions we provided these potential users with a range of devices running the application and only gave instructions for how to start the application. Note this process on describes the research and development up to release of the application “into the wild” from which point other evaluations will be utilized to inform subsequent development

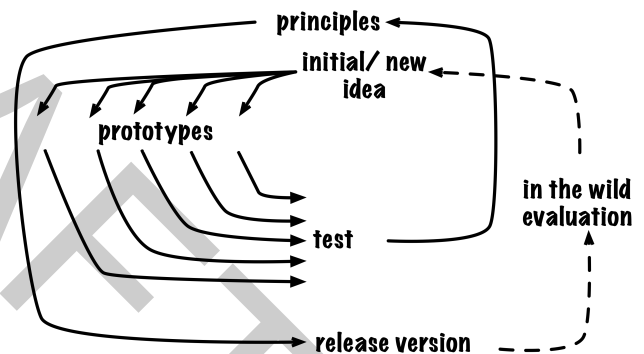


Figure 1. Application Research and Development process.

Note that application is being designed to be used across a range of Android devices and that part of the prototyping evaluation phase included an evaluation of the two main AR Software Development Kits (SDK) from Metaio® and Vuforia® in relation to the experience they provided. During these sessions we asked users to speak aloud their thoughts which were recorded and at the end of the sessions we held group discussions to capture what they liked/disliked about the application and potential new features they thought could improve the application. The features in the application described in the forthcoming paragraphs are the result of these sessions. Firstly however, we shall consider constraints related to the rights and views of the gallery and artists which also had to be incorporated within the application.

2.1 Insight #1: Publication and Copyright Constraints

It is evident that the creative industries built upon traditional media have struggled to adapt to the implications of the digitization of their content as they have become reliant on laws

relating to publication and copyright that were established in a very different era. Whilst many in the technological world may regard these laws as archaic, they are the expectation of galleries and artists. Therefore any augmented reality application intending to use images of artworks must take these conditions into account if the application is to be used outside a purely research context. Note that while following discussion is related to UK law, it is important that those developing MAR applications consider the corresponding laws of the countries within which they may wish to make the application available.

In the UK, copyright lasts for the lifetime of the artist and is transferred to their heirs for 70 years after their death. When an artist sells his work to a collector or gallery, the copyright for that work does not transfer unless an explicit agreement is reached.

In 1996 a further publication right was introduced, which effectively allows galleries, museums, public and private collectors, to effectively extend copyright after the 70 years after the artist's death has elapsed. The important thing to note is that this right is automatically given to the person or body that publishes the work for the first time in the EU after the original copyright has expired. As regards the meaning of 'publication' in this situation, it includes any communication to the public by: issuing copies of the work to the public; making the work available via an electronic retrieval system; renting or lending copies of the work to the public; exhibiting or showing the work in public, televising the work via broadcast, cable or satellite.

These laws obviously directly affect a gallery's ability to use artworks from their collection using AR. Copyright meant that specific permission had to be obtained for all the works featured in this application that were still subject to copyright law. In terms of publication right things are potentially more complex in cases where copyright expires during the time period that the artworks are being used by an application. For example, if an artwork is loaned for an AR application, then publication rights would reside with the gallery if they published the application. If the gallery publishes the application on an app store but uses the account of the developer who created the application, then publication rights would transfer to the developer. This latter scenario suggests that by default galleries and museums should publish applications using their own app store developer accounts to ensure they do not risk losing the publications rights of their artworks.

While the previous discussion suggests that artists are very well protected in relation to their work it was evident from the conversations we had that many view the digitization of their work with great suspicion and despite this protection one artist in particular insisted an explicit statement in the application that the artwork must not be used outside the application. Interestingly, a feature requested by the user groups was the ability to take a picture of what you were doing in the application to show your friends or even the ability to create a "selfie" or the user with the artwork. This highlights the challenge many museums and galleries face in an age where the ability to easily document your activities is the norm although one potential solution might be through the creation of ephemeral images such as those used in the application Snapchat® which only give the viewer a short time window to view the content before it disappears.

2.2 Insight #2: Image Resolution

It quickly became apparent during our discussions with the gallery that whilst there were digital images for many of the artworks, the resolution was quite varied, as the primary use of these images had been for recording and cataloging the collection. One of the clear results of the user testing was that the users particularly enjoyed it when they could explore the fine details of the images such as brush strokes within the paint. This was very evident with the students with physical and learning disabilities as one of student assistants remarked that the students on the whole, engaged more with the gallery content using the MAR, rather than visiting an actual gallery – because they could “get more involved” with the pieces – zooming in and out, rotating etc. if they were to go through a gallery space, they may just acknowledge “that’s a painting” passively, whereas the helpers felt that the students on the whole were far more engaged with the app. This is surprising, as one may expect users to interact more with gallery content when they are physically in the space. As an example of this level of detail, Figure 2 shows a photograph from the Chambers Bequest at the Peter Scott Gallery which was used as in the prototype to evaluate resolution. During these evaluations a number of people mentioned that they see the fingerprint present on one of the boys faces, which is also highlighted in Figure 2, which is not readily apparent when viewing the image in its entirety. To accommodate the desire for high-resolution images the gallery had to arrange very further images to be taken of the artworks that have been included in the application and this has been adopted as a standard practice for their digitization of artworks so that they could potentially be used within the application.



Figure 2. High resolution images allowing details such as the fingerprint on the face of this boy to be viewed by the users.

The use of high resolution images re-ignited concerns over storing images on the phone and increasing the opportunity for the images to be copied. Whilst these concerns could be addressed through the use of cloud services, it would affect the user experience on that the application in that it would need to maintain a network connection throughout its operation. To illustrate the effect on user experience to the gallery we created two versions of the application; one of which used on-board memory, while the other used cloud based services for both the storing of the images and AR marker detection.

From these tests it was evident that the locally stored content was faster to load and thus users felt it was more responsive and

therefore there was some debate as to whether we should store high resolution images on device. In the end, we created a system whereby low-resolution images are used to allow creation of a collection and to view the artwork details and the high-resolution images are loaded dynamically when an exhibition is viewed. If no network connection is available the application uses the low-resolution images.

2.3 Insight #3: Application Functionality

The application has been designed to provide a good user experience whilst using an aesthetic to emphasise the link between the artwork and the gallery. This is emphasized with the different functionality: create an exhibition, view exhibition, help, settings, being represented as paintings in a gallery as shown in Figure 3 a,b,c,d respectively. In the following sub-sections we shall consider the most important of these in regard to the user experience.

2.3.1 User Exhibition Creation

As discussed previously, a key motivation of this project is for users to engage with the gallery collection and the application allows the users to create and then share. In the current version, the number of artworks that can incorporated by the user has been restricted to three, primarily to reduce complexity as shown in the top image of Figure 4. The order of selection corresponds to the order in which the user defines their three AR markers which will be discussed in a subsequent section.

Having selected their chosen artworks the user gives the exhibition a name and provides a description as shown in the lower image of Figure 4. At this point the user can also define how they wish the artwork to be displayed in relation to the AR marker. They can choose either: to display proportional to the height of the marker; display proportional to the width of the marker; display at the original dimensions of the artwork; define a custom display size. In Figure 4 the three images have been set to original size for display.

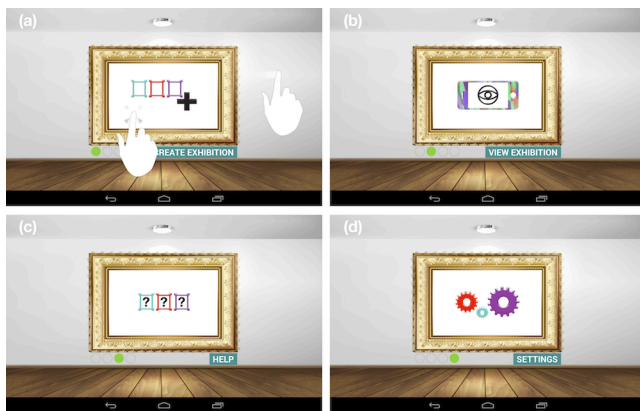


Figure 3. Application Navigation

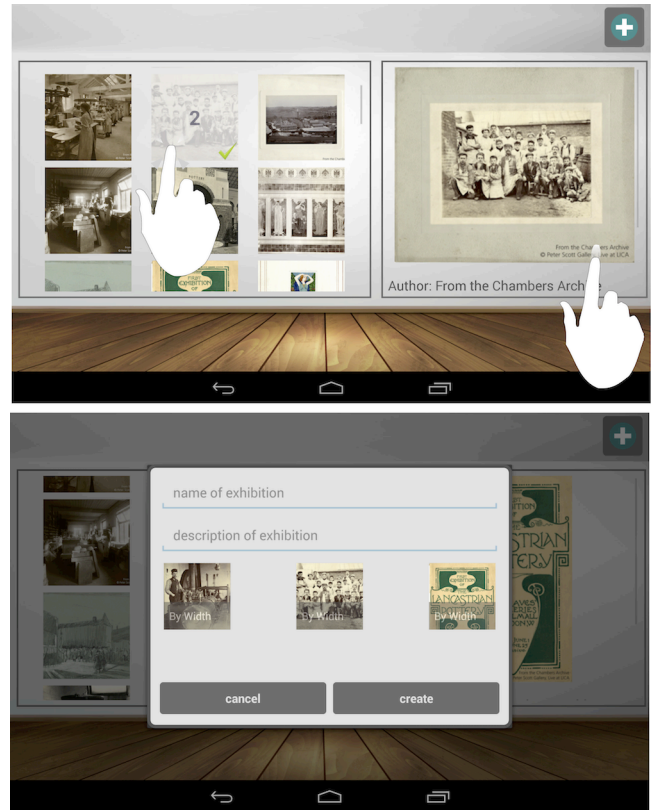


Figure 4. User Exhibition Creation

2.3.2 View Exhibition

As discussed previously, a key motivation of this project is for users to engage with the gallery collection and the application allows the users to create and then share. In the current version, the number of artworks that can incorporated by the user has been restricted to three, primarily to reduce complexity as shown in the top image of Figure 5. The order of selection corresponds to the order in which the user defines their three AR markers which will be discussed in a subsequent section.

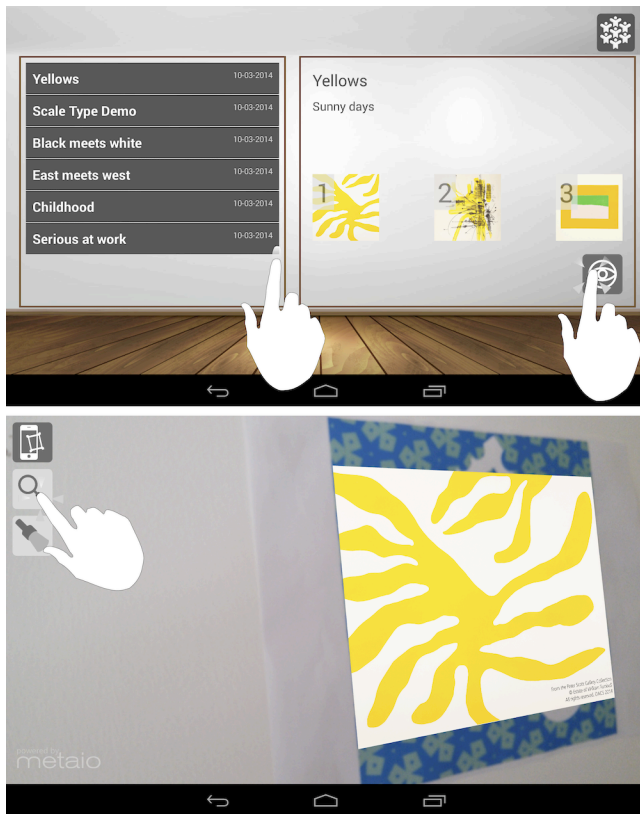


Figure 4. View Exhibitions

2.3.3 AR Markers

The application is set-up so that the default is to use the three AR markers we created for the project, and are available to download by the user, or the user can define three markers of their own in the settings menu. The user definition process is shown in Figure 5 and in the application we suggest users utilize pictures hanging on their own walls for this purpose.

In the user evaluation whilst users preferred the stability of Vuforia over Metaio when viewing markers at close range although while both SDK's evaluated support user defined markers it was the ability of Metaio to do this locally on the device rather than in the cloud that ultimately led to its selection over Vuforia.

3. CONCLUSIONS

In this paper we have considered the implications of designing MAR applications using content from museums and galleries, not from a primarily technologically driven perspective but rather one that includes the users, artists and galleries.

To ensure the project provides both useful insights for the wider arts sector whilst recognizing that many potential users will have little or no experience of AR we adopted a MAYA approach to the design.

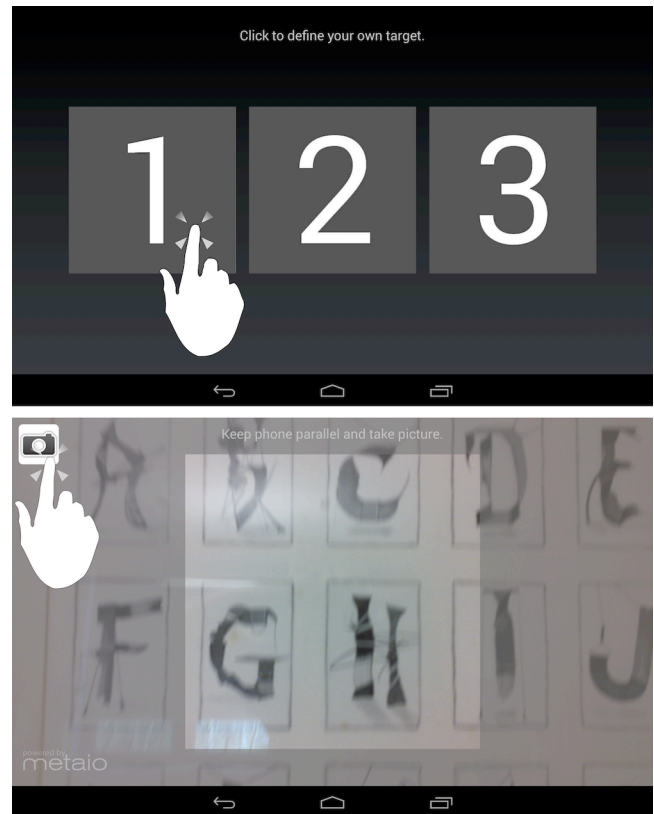


Figure 5. AR Marker Definition

This led to a series of user tests utilizing iterative prototypes which allowed us to optimize the user experience. In particular it allowed us to explore aspects of the design driven by the concerns artists and gallery which directly affected the user experience we were able to create. Of particular concern to artists and galleries are the laws relating to the rights over the images used in the application. What was evident from this process is that in many cases were apparent conflicts occur solutions can be found by involving all parties within the design process.

One aspect of rights management of particular concern to galleries is that publication rights the come into effect once an artwork goes out of copyright which dictate that museums and galleries should ensure that any applications created should be done through their own developer accounts. These issues were undoubtedly highlighted more in this project as it was funded under a research and development fund rather pure research. This meant that releasing the application 'in the wild' was always a requirement and thus it has highlighted many of the non-technical issues galleries and museums face with MAR.

Whilst we believe the iterative approach to the design of the application described in this paper has created a compelling user experience, we intend to continue this iterative process after the forthcoming release of the application. This process of continual development is also an unusual activity for many galleries who are more used to fixed time span projects and therefore has to be considered within the funding of such activities.

Finally we would reiterate that if cultural organizations are considering the use of MAR for their collections they should ensure they and their potential audience are involved within the

design and development process if they are to create a user experience that is acceptable to all.

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