# Collaborative Research through Design

## A Case Study in Mobile Augmented Reality

Dr Paul Coulton
Lancaster Institute of Contemporary Arts
Lancaster University
Lancaster, UK
p.coulton@lancaster.ac.uk

Dr Emma Murphy
School of Design
Glasgow School of Art
Glasgow, UK
e.murphy@gsa.ac.uk

*Abstract*—**In this paper we outline the challenges and preconceptions that we have experienced in "Taking the Artwork Home", a collaborative research project across art, design and technology. The project uses Mobile Augmented Reality (MAR) to explore ways to enhance engagement with the arts and in this paper we present the challenges relating to performing this type of research more generally as well as specific insights for the sector relating to image based applications.**

*Keywords—design; research; Mobile Augmented Reality; arts; technology; museums*

## I. Introduction

The UK research agenda frequently calls for more cross-disciplinary research, and now emphasizes the importance of impact beyond academia by directly engaging with stakeholders through research in the wild [1]. This paper exemplifies this approach to research in that it is a collaboration between an arts organization, design research academics and a technology developer to investigate challenges of creating a novel Mobile Augmented Reality (MAR) application to engage new users with gallery content.

The innate diversity of these collaborative endeavors can result in novel findings from the research itself (in this case, about the development of an MAR application to engage users and develop new curatorial strategies), as well as new insights into the design and practice of such a research approach (in this case, the complexities of doing research in the wild). In addition, such an interdisciplinary workspace can reveal preconceptions from edge audiences, which emphasizes the importance for researchers to collectively reflect, bolster and clearly articulate their approaches and outcomes.

This paper will firstly describe the complex nature of this project, in terms of funding landscape, diversity of partners and audiences. It will then outline the research process, challenges experienced, and the implications for such projects in the future. It will conclude by detailing the novel insights that the project has generated in terms of application development, and future plans beyond the current project funding.

## II. Research Proposition

Our initial research aim was to identify the potential of digital technologies and social media – with a particular focus on MAR - to engage the public in art collections through curation of, and responding to their personal exhibitions. We also wanted to identify how user-generated content could inform future curatorial and collections strategies. In addition, we wanted to understand the implications this would reveal for the wider arts sector, particularly regarding access, rights management and intellectual property (IP).

## III. Research Methodology

The project was funded through Nesta Digital R&D program which aimed to support the use of digital technology to build new business models and enhance audience reach and therefore this project needed to demonstrate aspects of both research and development. This necessitated flexibility within the research approach and with the creation of the artefact, in this case the MAR mobile application. The research approach adopted closely aligns to Sir Christopher Frayling's definition of 'research through design' [2, 3], in that research into the possible implementations of MAR were evaluated with different user groups as part of the design process and that the research reports and papers produced primarily reflect on this process to suggest approaches that are both desirable and productive for future practice [4] rather than analyse the artefact itself. The project can also be considered as 'research for design' [2, 3] in the sense that the end product is a prototype artefact in which all the thinking that went into producing it is embedded, and in the sense that it is not simply a finished ready-to-market app, but more an artefact in perpetual beta with implications for designers to take further. One could argue that the artefact represents more divergent thinking of *'what could be'*, as opposed to a developer or consultant view of something most possible or practical. Furthermore, whilst the development of the artefact is able to produce a series of insights once it is released 'into the wild' many others are likely to emerge [1] as the project uses Agile development these insights will influence new versions and the project effectively remain in perpetual beta.

As one of the aims of this project was to produce a radically new experience for a general audience, their role in the process has to be considered carefully. To quote Marshall McLuhan from his book the Medium is the Massage *"We look at the present through a rear-view mirror. We march backwards into the future"* {5}. In other words our views of *what could be* are highly influenced by what we have

experienced. This view seems very applicable when considering the current state of public, and indeed many cultural organisations, 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 simple sensor-based AR systems such as Layar or Wikitude (//www.layar.com, //www.wikitude.com) which provide a very different user experience than vision-based approaches used in this project [6].

Therefore we decided not to utilise a co-design approach, because rather than act as facilitators for the users who would design the application, we developed the system 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 shown in the figure 1.
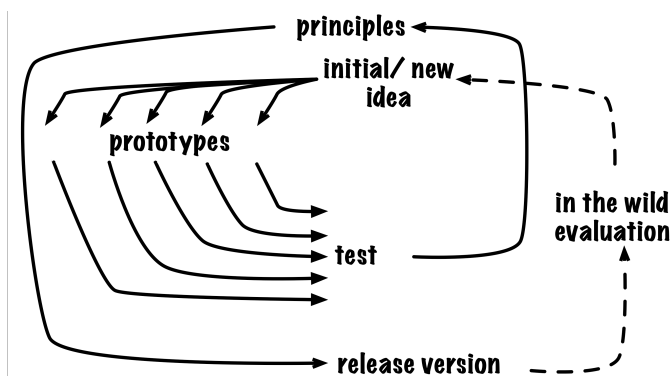


Fig. 1. Taking the Artwork Home: Research and Development Process

The challenges and insights in the forthcoming discussions are derived from these sessions involving five versions of the application and 80+ volunteeers. Note the figure 1 also indicates the 'in the wild' evaluation phase in which we will use feedback from those who have downloaded the app to provide further improvements of the application.

IV. CHALLENGES

There are a number of key challenges which were addressed during the course of the project. Such challenges could be valuable to others considering collaborative research through design – particularly when there needs to be balanced between research and development for both academic and non-academic stakeholders. Challenges are summarised in the table below.

*Challenge 1:* Defining desirable outcomes (e.g. tangible product outcomes versus intangible research outcomes). This challenge came about because of the different expectations of outcomes in this kind of research project: e.g. research through design. Learning about the process of research through design is important, as many new and pioneering research calls are geared towards enabling and encouraging this kind of collaboration. We know we should work in this way, e.g. using research findings to inform design – but also learning through the design process, but how does it actually happen? How is it communicated in a way that makes sense to multiple

stakeholders when doing research "in the wild"? If research projects involve the development of an app, how do we ensure this is research about what could be, as opposed to the development of a market ready project, which could arguably be classed as consultancy. We overcame this challenge through regular communication with our stakeholder groups, but also being clear from the outset that the purpose of an academic research project was very much about the research processes which lead to the creation of prototypes that represent proof of concept and potential, rather than finished and developed solutions. When the outcomes were clarified, we found that all partners were indeed happy with proof of concept and prototypes as outcomes – it was more about being clear with expectations.

| *Challenge* | *How this was overcome* |
|---|---|
| Defining desirable outcomes | Open and frank discussions about what outcomes are required for all members to benefit from the project |
| Research ethics and IP and how these can negatively impact the scope of the research | Inclusive discussions throughout the project with all stakeholders about both the choices to be made and the potential impact of such choices |
| Overcoming preconceptions about this kind of research from potential audiences. | Prototyping to learn not simply testing functionality |

Table 1: Key Challanges

*Challenge 2:* Research ethics and IP and how these can negatively impact the scope of the research. When academic research is done, there is inevitably ethics approval needed, and procedures to follow. During the course of this research project we have been confronted with a number of interesting questions about ethics. Participatory research practice can be viewed as being, in itself, an ethical approach to research in that it involves a high degree of accountability and responsibility towards the research participants. The approach requires ongoing reflexivity and sensitivity to emergent ethical issues. However, difficulties can arise in addressing the structured requirements of ethical review processes particularly in relation to ensuring informed data protection when some activities are conducted in the wild and the researchers may not have direct contact with the users of the application. Whilst from a cultural organisation perspective it could be that the more information available from users the better insights they may have, from a university ethics perspective we should only collect information that is directly relevant to the project for which informed consent from the users should be obtained.

To this end we deliberately obtained much less personal information through the application than we did through the participatory design process and through discussion with the university ethics committee developed a set of terms and conditions that effectively provided the information that would normally appear on the physical form given to users. The users also have to check boxes to say they have read and accepted this information before they are able to use the application as shown in Figure 2.
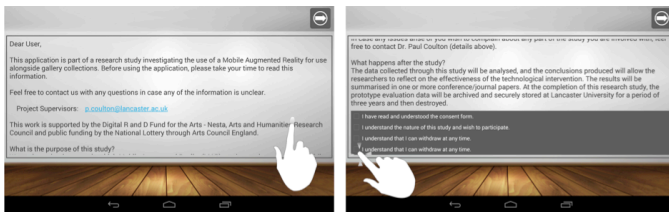
Fig. 2. Informed Consent

*Challenge 3:* Overcoming preconceptions about this kind of research from potential audiences. As highlighted earlier people have very little experience of what they may encounter in the future and their answers are usually based upon what they understand today. Therefore part of the challenge for this project was how we could concretize the concepts of MAR for potetial users in such a way as it allowed their views and opinions to be drawn on to consider the potentiality of these futures. Therefore, the protyping performed in this project, particularily within the early stages, should not be considered as not simply creating an early version of the application functionality to be released but as a thing to be learned from by all of the stakeholders within the project. In this way the stakeholders evolved beyong simply experiencing a 'cool' technology  to one whereby they could explore the future potential .

## V.  CONCLUSIONS AND NOVEL INSIGHTS

The paper will conclude by describing some novel insights, useful for designing for users with disabilities, as well as the implications for future research.

### A.  Novel Insight 1: Open Source

During the course of this project, we are observed through interacting with the other Nesta R&D projects that there was often a great deal of internal politics regarding IPR in doing this kind of research, especially in instances where for example, the partner organisations weren't pre-formed (unlike ours) and had undergone a matchmaking process. We managed to avoid such issues – as we were a group that pitched the project together – and agreed from the outset that we wanted to make as many of the outputs open source as possible to enable as many organisations to benefit from the work. For the academics involved this required a discussion with the commercialisation manager prior to the project to agree that while the project is very innovative from a research perspective because we were deliberately using commercial devices to ensure others could re-create the work and thus were unlikely to create outputs that were patentable. Whilst we could cover the software with copyright if we wished to exploit it commercially, it was felt that most benefit to a wide range of users would come if we enabled as much of the project as possible to be used by other organisations without charge. This was a key interest for the gallery, coming from a sector that encourages support and sharing of knowledge Taking the Artwork Home provided an opportunity to give access to technology that would otherwise be out of reach for most institutions which are too small to instigate this type of innovation.

### B.  Novel Insight 2: Cross-Device Compatibility

Despite concerted effort over recent years to consolidate the market for creating mobile applications it still remains fragmented. When developing very technical applications, such as the one produced for this project, choices have to be made as to what devices will be supported. Whilst Apple and its IOS operating system are arguably the most well-known, according to the International Data Corporation report of smartphone sales in 2013, Apple had a worldwide market share of 13.2% while Android achieved 79.3% with the remaining share going to the likes of Windows Phone and Blackberry (Note very similar figures were also presented by Gartner for this period). Although this alone might suggest Android is obvious choice it is not that simple. All these operating systems have evolved over a number of years and many systems and features are not backwards compatible and the actual smartphones that users' possess will be spread across this evolution. All this means that choices have to be made as to which versions of the operating system will be supported and all of these will need to be tested before release. Beyond the operating system there are also features that vary from device to device such as screen size, processor speed, memory etc. As there is no common agreed standard, the look and feel of the application may be different on every device. The overall effect is that even for a fairly modest coverage of devices the application needs to be tested across 10-15 different models to ensure correct operation.

### C.  Novel Insight 3: Publication and Copyright

It is evident that the creative industries built upon traditional media have struggled to adapt to the implications of the digitization of their content after becoming 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 artwork must take these conditions into account if the application is to be used in the public domain.

The laws relating to Copyright and Publication Right obviously directly affect a gallery's ability to include artworks from their collection in an AR application. 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, the situation becomes 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 used 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.

*D. Novel Insight 4: 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 cataloguing the collection. One of the clear results of the user testing was that the users particularly enjoyed the ability to 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 college assistants remarked that the students on the whole, engaged more with the gallery content using the MAR, as opposed to when they physically visited galleries – because they could "get more involved" with the pieces – zooming in and out, rotating etc. Further commenting that when moving through a gallery space, they may just acknowledge "that's a painting" passively, whereas the college assistants felt that the students on the whole were far more engaged by using the app. As an example of this level of detail, Figure 3 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 the Figure below; an aspect 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 for artworks to be re-digitised for the application. This new way of handling images has been adopted as a standard practice within gallery's collection management and will allow the wider collection to be used within the application.



Fig. 3. Advantage of High Resolution in AR

## VI. BEYOND THE PROJECT

In the short term, The Peter Scott Gallery is preparing and negotiating additional artworks to enrich the application content. They are able to add this directly themselves without the need to modify the application on the app store using the support tools developed. It is our hope that by the Peter Scott Gallery showing this technology to their peer organizations they will encourage others to do the same. We are also considering adding support for the major social media platforms within the app to help raise awareness as part of our publicity efforts.

We are pleased that the project app is already acting as a living archive for the Peter Scott Gallery, and providing them with real time information on its use among the community and overall we believe that the insights developed from this research will prove invaluable for the sector as a whole.

## *References*

[1] P. Coulton, W. Bamford. "Experimenting through mobile 'apps' and 'app stores'." International Journal of Mobile Human Computer Interaction (IJMHCI) 3, no. 4 (2011): 55-70.

[2] C. Frayling. "Research in Art and Design". Royal College of art Research Papers,(1993), 1(1), 1-5.

[3] L. Frankel and M. Racine. "The Complex Field of Research: for Design, through Design, and about Design". In Design & Complexity (pp. 043): Design Research Society, (2010), 43.

[4] W. Gaver. "What should we expect from research through design?." In Proceedings of the SIGCHI conference on human factors in computing systems, (2012), 937-946. ACM.

[5] M. McLuhan, and Q. Fiore, and J. Agel. The medium is the massage. New York, Bantam Books, (1967).

[6] P. Coulton, R. Smith, E. Murphy, K. Čopič Pucihar, and M. Lochrie, "Designing mobile augmented reality art applications: addressing the views of the galleries and the artists". In Proceedings of Academic MindTrek Conference, (2014.) ACM..

[7] Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, "Electron spectroscopy studies on magneto-optical media and plastic substrate interface," IEEE Transl. J. Magn. Japan, vol. 2, pp. 740-741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982].

[8] M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.