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Digital Creativity and the Regional Museum: Experimental collaboration at the convergence of immersive media and exhibition design

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This paper presents the findings of the Within the Walls of York Gaol, an interdisciplinary and collaborative practice-based research project which was established to examine the intersection between emerging forms of immersive media, game design and contemporary archaeological exhibition design. The project was a collaboration between researchers and practitioners at York Museums Trust, The University of York, and the University of Glasgow and used co-design methods to design and produce two immersive installations in the prison cells at York Castle Museum in collaboration with community groups.The project sought to re-think the role of the museum within regional creative economies and to argue for the importance of the regional museum as a hub for digital design and innovation. Through innovative forms of collaborative research practice the project was able to develop new understandings of the ways in which collaborative approaches to the design and development of interactive digital media can be used to build skilled communities of practice around regional museums. The project took a critical stance to the use of immersive media technologies and led to the development of innovative and highly distinctive digital immersive installations which emerged in response to the specific opportunities and design requirements of museums and their audiences.This paper will set out the findings of this project as well as identifying new creative directions and new forms of collaborative design practice which can be adopted and adapted for use across the museum sector.

CCS Concepts: • **Human-centered computing** → *User studies*; **Mixed / augmented reality**; • **Applied computing** → **Media arts**.

Additional Key Words and Phrases: human computer interaction, digital heritage, museums, archaeology, augmented reality, interface design, user studies, collaborative design, co-design

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1 INTRODUCTION

Within the Walls of York Gaol was an interdisciplinary and collaborative practice-based research project which sought to examine the convergence between emerging research into immersive media, game design and archaeological exhibition design. The project was conducted through the collaborative design, development, installation and evaluation of two digitally immersive installations at York Castle Museum in England. The project sought to better understand how collaborative approaches to the design and development of interactive digital media projects might (a) be used as a springboard to provide museums with long term access to high level creative digital skills and (b) enable the development entirely new forms of immersive media which respond to the needs of museums and their audiences.

Within the Walls of York Gaol is the second phase of the Digital Narratives in Archaeological Research (DiNAR) project. DiNAR was set up by York Museums Trust, The University of York, and the University of Glasgow in 2017 to transform museums' participation in the design of interactive digital media. The first phase, *VikingVR* [Digital Creativity Labs funded EP/M023265/1], was an experimental Virtual Reality (VR) installation which ran from 16th May – 5th November 2017 [30]. The second phase, *Within the Walls of York Gaol* [AHRC awards AH/R008701/1 and AH/R008701/2], took place over a 12 month in period in 2018 and is published here. This took the form of a series of experimental event-based immersive installations situated within the 18th century prison buildings at York Castle Museum. The third phase, *Digital Creativity for Regional Museums: Immersive Experiences Smart Commissioning Toolkit* [AHRC award AH/S010483/1] is ongoing and will be published in 2023.

The DiNAR project set out to develop new and sustainable modes of collaborative design practice to enable museums to participate in the design of innovative forms of digital media and to ensure that local and regional creative economies benefit from the resources, audiences and skills which museums are able to bring to bear. The project was built on the development of cooperative creative models which harness skills present within regional museums and which utilise the potential of these organisations to be active agents in the design of innovative digital media.

1.1 Phase One: VikingVR

During the first phase of the DiNAR project the *VikingVR* installation challenged the research team to (a) develop interactive media for museums which are more innovative, relevant and engaging than would be possible using conventional models of commissioning and (b) formulate models for collaboration which improve on conventional commissioning models and which are more rewarding and productive and which draw upon the skills of museum professionals as well as other practitioners and researchers [30]. *VikingVR* used established approaches to technology and media with mobile VR used to deliver a series of single location animated VR panoramas. This installation used established and robust approaches to ensure continued functionality for the duration of a six-month exhibition. Innovation within *VikingVR* derived instead from the design and staging of the installation and the way in which it was integrated into the larger exhibition.

1.2 Phase Two: Within the Walls of York Gaol

In contrast to the research outlined above, *Within the Walls of York Gaol* placed the emphasis on experimental practice and emerging technology. The installations for *Within the Walls* fulfilled a strategic role at York Museums Trust by contributing to the development of new curatorial strategies for the ongoing redevelopment of the Castle Museum complex. *Within the Walls* was an exploration of the idea of site-specific immersive media within an historic environment. Where *VikingVR* had been situated within a white box gallery, Within the Walls took place within a series of 18th Century prison cells (see figure 1).

The project was based around two research goals. The first goal was to design, install and evaluate a series of site-specific immersive installations based at York Castle Museum. The creative process underpinning this work

Fig. 1. A general view of the York Castle Museum. Photograph by N.Smith [Public Domain]

enabled the research team to explore the opportunities and challenges of immersive media for archaeological storytelling in museums and the interplay between immersive experiences and artefactual and architectural material culture. This part of the project enabled us to investigate the narrative affordances of immersive media and to consider how (when delivered through different forms of immersive technology) immersive experiences might be meaningfully integrated into an historic environment. A primary goal of the project was to explore the interplay between immersive media and historic buildings for delivering new forms of museum experience. The primary research question for this part of the project was:

How can VR be used to effectively evoke memory and place within gallery spaces in dialogue with physical experiences of archaeological objects and spaces?

The second goal was to reflexively evaluate our collaborative practice to develop a series of re-usable design principles for conducting collaborative interactive media projects based at museums. By approaching our work in a reflexive way, we were able to refine and adapt our collaborative practice and to develop an understanding of the demands and opportunities of new ways of working. As the project progressed, we began to better understand the dynamics of our collaboration and were able to identify expertise across the participating creative community.

We were able to develop a collaborative creative model which enabled a diverse research team to contribute to and refine the installation. Collaborative practice was re-configured throughout the project with different forms of design practice adopted at different points. Our approach to design practice was informed by co-design principles and methods from Human Computer Interaction (HCI) [29][37] and was designed to support team members to contribute to areas of the project which fell outside of their normal areas of expertise or professional roles. We did this in order to (a) enable professional development and knowledge transfer between different team members and partner institutions and (b) ensure that our design model was as flexible, scalable and transferrable as possible to different research teams and different research contexts.

The primary research questions for this part of the project were:

(1) How can commissioning processes be configured to enable better knowledge exchange and better design practice?
(2) How can collaborative relationships between museums and digital media creators be configured to be more sustainable, productive and rewarding?
(3) How can co-design be used to produce digital media which are more responsive to the needs of museums and their audiences?

2 CONTEXT

Interactive digital media have been an important component of archaeological exhibition design for several years. Enthusiasm for new kinds of experiences and modes of engagement has helped to ensure that museums have continued to champion and make space for emerging digital and analogue media forms [17][18][23][25][34]. In the UK, interactive digital media have not just been the preserve of larger or national museums, this content has very often been commissioned, designed and developed locally at smaller institutions with limited resources [25][30]. This kind of local innovation provides a model for the kinds of dynamic regional creative economies currently being promoted by governments and intergovernmental organisations in the UK and elsewhere [9][36]. However, skills deficits within the museum sector, financial and time constraints and current business models mean that opportunities for collaboration and knowledge exchange between museums and media creators have been limited [22][24][23]. This has restricted the ability of small to mid-sized regional museums to meaningfully participate in the design of interactive media installations, with an acknowledgement within the sector of a digital skills deficit [38]. As a consequence, the interactive media produced have very often not been as relevant or appropriate to museums or their audiences as they might have been. However, the practice of designing and delivering museum exhibitions has become increasingly collaborative and increasingly interconnected with other elements of the cultural landscape. Contemporary exhibition design is very often dependent for its success upon the combined efforts of a diverse community of practice drawn from a range of specialisms [4]. This expansion in the field of expertise applied to exhibition design has created a need for new modes of collaboration and commissioning [32]. This need has been particularly acute around the development and implementation of emerging and experimental digital technology within museums. In recent years, museums in the UK have hosted, supported and contributed to the development of experimental digital media and have incorporated digital media into exhibition design in creative ways [2]. However, the technical and creative skills needed to design and realise innovative digital media projects are not generally present within museums with this absence being particularly felt at local and regional levels [5][23]. Museums are centres of expertise in immersive and interactive storytelling, albeit usually specialising in analogue rather than digital media. The theatrical character of museums has been widely discussed [4][17][19] and the relevance and transferability of pedagogic, design and storytelling skills present within museums to the design and development of digital games and interactive media has been increasingly recognised [25][26][27][30]. The museum sector has a living tradition of enabling innovative and transformative cultural experiences to take place [4][17]. If this tradition is to extend into the era of interactive

digital media then it is imperative that methods are developed which enable museums to meaningfully participate in digital research, design and development just as they have contributed to developments in theatre, design and other cultural forms. In fact, museums could be at the forefront of digital innovation as spaces that enable social inclusion [12].

3 DESIGN PRACTICE

The design of *Within the Walls of York Gaol* was motivated by the needs of York Museums Trust (YMT) and set out to conduct experimental work which would allow YMT's digital interpretation to innovate in specific areas. The project took place against the backdrop of the Castle Transformation Project and My Castle Gateway, two major initiatives to transform York Castle Museum and the surrounding area of York city centre [20]. The preserved prison cells are situated in the lowest floor of York Castle Museum, a former 18th century prison overlooking York Castle. The prison cells which formed the focus of this project are on the primary visitor route through York Castle Museum and, as such, represent a significant opportunity for interpretation within this landscape. This project provided an experimental space within which to test the value and affordances of immersive installation as a component of the museum's offering both on-gallery in bespoke spaces (as was the case in the *VikingVR* project) and in historic buildings and environments (as was the case in *Within the Walls*). The *Within the Walls* project set out to transform the use of historic buildings by demonstrating their value as venues for immersive media. The co-design process took place over several stages. Each stage was configured to facilitate specific kinds of design activity with specific audiences. Each of these stages is outlined below with a summary of the ideas which emerged at each stage. As is evident in this account, the design emerged in response to a wide range of collaborative activities and altered as the design process continued. This was a reflexive design process which took account of ongoing developments in the project. It was also pragmatic and sufficiently flexible to sit alongside established patterns of work and decision making within the museum and universities.

3.1 Workshops

Design work was undertaken using a range of techniques derived from and developed out of techniques used within exhibition design and HCI. We focused on narrative and aesthetic design and technology and implementation as two distinct themes in order to emphasise the importance of 'soft' design and creative skills alongside the technical aspects of project development. Workshop 1 (see figure 2) was a co-design workshop led by Masinton, Beale, Hook, Schofield, and Smith in conjunction with staff from York Museums Trust. The workshop was an opportunity to open the design process to a broader creative community. Participation in the workshop was open to the public via a free ticketing system. 25 attendees from outside of our research team attended and contributed to the design process. This included high school teachers, theatre designers, authors, sound artists, students, media developers and software developers.

The workshop was structured around the production of exhibition prototypes and/or design concepts during a two-day period. During the workshop participants and research team members organised into groups of 5-6 people and collaborated on the design of immersive experiences for the prison cells at York Castle Prison with support from the curatorial staff who posed a challenge: to design an experience which (a) linked the cells to the rest of the prison site and (b) addressed the fact that as the final part on a visitor's journey through the museum the cells are frequently overlooked and have very low dwell times. Groups had free access to the museum itself as well as having access to museum archives, digital technology (VR headsets, computers, camcorders and sound recorders) and craft materials. Groups were asked to work on the development of a prototype installation; unlike conventional 'hackathon' style events, however, this prototype could either be digital (using the equipment detailed above) or analogue (produced using the craft materials). All groups were introduced to paper-based design but were also challenged to think creatively about the form a prototype might take. The workshop was

Fig. 2. Attendees at workshop 1 are introduced to the day's tasks by Helen Langwick and Gareth Beale within the setting of York St. Mary's, York Museums Trust. Photograph by N.Smith [Public Domain].

designed to enable all participants to develop new skills and knowledge. Specialists from outside of our project were funded to attend specifically to and guide and enable participants' learning. This included senior academics and senior practitioners from the creative sector including representatives from the Fitzwilliam Museum and Central St. Martin's College of Art and Design. Workshops were conducted in the nave of St Mary's Church in York as part of YMT's programme of public consultation on the future of York Castle Museum, with frequent visits to the museum nearby. Members of the public visiting the space were invited to participate in discussions and to trial prototypes produced by participants and feedback was informally incorporated into prototypes as workshops progressed. The workshops ended with the discussion of ideas to an audience of senior staff from York Museums Trust. Workshop 2 (see figure 3) was a creative writing and performance workshop aimed specifically at 'front of house' from York Museums Trust. Led by researcher Masinton, the workshop provided an opportunity for York Museums Trust staff to participate in the design and development of the Whispering Graffiti experience. Participants produced and performed short dramatic monologues based on archival evidence of 18th Century

prisoners. The workshop provided an important opportunity for staff members from across the organisation to take a meaningful creative role in the production of a new installation.

Fig. 3. Attendees working on their prototypes at workshop 2, within the setting of York St. Mary's, York Museums Trust. Photograph by N.Smith [Public Domain].

The workshops were intended to catalyse the design process and to open the process up to a broader constituency of designers and makers than would have been possible within a conventional commissioning model or design methodology. They were designed to be self-contained events in the sense that participants could limit their involvement in the project to the attendance of a single workshop and could benefit from this activity through the development of new skills and knowledge. However, participants were given the opportunity to join the research and development team and to continue their involvement in the project. Of approximately 30 participants at the workshops, three joined the research team and contributed to the development of the final project. The majority of the original participants (90 percent) attended the installation events and contributed to the evaluation of the project.

3.2 Workshop Results

Installations designed by groups at the workshop were extremely diverse. Technologically, creatively and in terms of subject matter the projects varied greatly, however several themes emerged which cut across the groups, and which inspired aspects of the final design. These were: **(1) The importance of experimental forms of media production and modes of storytelling.** Several groups took creative approaches to the use of media, particularly sound, and challenged our assumptions about the role of digital media in the museum experience. They also challenged current understandings of immersive experiences. This included a project which proposed the production of abstract layered soundscapes which could be experienced as the visitor passed through the museum space. This, and indeed other groups' responses, rejected linear storytelling approach in favour of a non-narrative and non-representational use of media within the museum environment. These ideas were outside of the research team's initial conception of an immersive experience and contributed greatly to our thinking about the way in which media interact with the built environment to create a sense of immersion. **(2)** Closely related to this point was **the idea of the museum as a venue for a range of media experiences**. A specific example proposed by one group was a game which could be played within the cells. There are clear sensitivities around the way in which a space such as this can be used for play. However, the idea that game-like experiences can be used to tell difficult stories in a thoughtful and sensitive way was instrumental in the design process. **(3)** Finally, several groups emphasised **personal stories of prisoners**, rather than dealing with the history of the building. One participant noted *"that the building itself had a solid and almost oppressive presence which needed to be counterbalanced by remembering the people who had been there and their ephemeral stories"*. These thoughts arose out of a discussion of the harshness of the 18th and 19th Century criminal justice system in the UK and the fact that many of those imprisoned at York Castle had committed minor crimes and received punishments which are disproportionate by today's standards, for example, transportation for the theft of food. The idea of re-populating empty cells and of bringing out the personal stories of people who suffered historical injustice was instrumental to the final design.

3.3 Participation and Observation

The finalised design concepts were shaped and refined through extended discussions and co-working between researchers and museum staff. These discussions began immediately after the workshops and continued throughout the design process. In contrast to the intensive model of workshop-based design this stage of the design process took place over a longer time period (approximately 6 months) and allowed for the slow development of ideas though the co-presence of project members from different organisations within the same space. During this period the university-based research team embedded themselves to as great an extent as possible into the life of the museum, observing and participating in meetings relating to museum strategy and development and co-working with the museum digital team. By being co-present we were able to directly address the design of the installations, but we were also able to collaborate on other small technical and design projects. This kind of reciprocal sharing of expertise enabled us to engage in slower and deeper critical thinking and creative experimentation which would not have been possible within a conventional goal-orientated and time limited structure. It also allowed to us deepen our engagement with the larger museum community and to involve front of house museum staff in the design and realisation of the experiences in addition to the digital and design teams. The nature of these collaborations and the decision-making processes that accompanied them is outlined in more detail below as we describe the development and realisation of the installations. The workflow for design of the AR installations worked to first identify the needs of the museum staff and museum goers as well as the needs of the building itself, in sympathy with the plans for redevelopment. Several methods were employed for this task, including meeting with staff to workshop ideas, and in-gallery observation of current space use and analogous spaces held by YMT to be 'successful' in interpretation: namely Kirkgate Victorian street. Observation was carried out

in the museum in order to gain a more in-depth understanding of the challenges presented by the setting and the history of the building. In particular, the team focused on conducting visitor observation in the Kirkgate part of the museum (figure 4). This is a reconstructed Victorian street with original shop fronts on display in which costumed interpreters walk amongst museum goers engaging in conversation. Shop fronts act as open storage and consequently artefacts on display have little associated labelling. Interpretation is provided via live engagement with staff and volunteers.

Fig. 4. A general view of Kirkgate Victorian Street at York Castle Museum. Photograph by N.Smith [Public Domain].

Our approach to observation aimed to identify visitor motivations, as per Falk's identity-centred methodology [14], by considering motivational categories as a way into considering the user needs for future installations. Observation was adapted for the specific setting [1]. Over several days, time was spent undertaking semi-covert observation (signage was provided in the museum reception), noting behaviours and comments relating to the interpretation. Findings from this observation indicated that visitors were keen to take part in the conceit of time travel through engagement with the setting. Visitors enjoyed the playfulness of placing themselves into the past, a behaviour we had seen in VikingVR [30]. The costumed interpretation certainly offered an enriched experience for some of the visitors, in the same way that Turner & Peters' recent analysis of the costumed interpretation at

the Galleries of Justice in Nottingham demonstrated an emphasis on 'genuine' and 'authenticity' [35], but there was also a clear response by many of the observed museum goers who were seeking individual or small group contemplation of the artefacts on display. These focused on putting themselves into the past through the objects that they responded to on a personal level. This was revealed in conversations between research participants motivated by how it would have felt to have lived in the period represented. The majority of these personal responses were prompted by objects that were simultaneously familiar and unfamiliar. Questioning the purpose of an artefact seemed to lead to a more lively engagement with the past. The general setting, along with the immediate context of the artefact seemed to be the key mechanism for imagining the past. This presented a design challenge; could we replicate this using setting and digital technology? We adopted an approach of designing experiences that facilitated embodiment in the past, identifying methods to reduce the space between past and present and these are outlined below. On-gallery observation and participation in the working life of the museum were both instrumental in ensuring that the installations which we produced fitted into the museum visitor experience and reflected the needs of museum visitors and staff. The ways in which these activities influenced the final designs is discussed below.

3.4 Evaluation Methodology

Because of the experimental nature of the installations it was decided to conduct evaluation at a series of events at York Castle Museum (see figure 5) during which the installations would be set up for visitors to use. One evening event was arranged with a range of participants drawn from museum staff and York's creative and cultural heritage community. This event had approximately 40 attendees and was designed to test the robustness of the installations and to conduct initial observations of user behaviour. A large prison cell was used as a space for socialising and short talks relating to the project. Over the course of an evening, 40 participants were led in groups from this room into smaller cells to take part in the experiences described below. As well as serving a practical purpose by allowing the research team to manage access to the experiences, this event format demonstrated the potential of historic environments and museums in particular to function as venues for innovative and experimental media experiences. This is discussed at greater length below. Evaluation of the events was undertaken via researcher observation and also through the use of feedback cards and longer surveys, collected in boxes during the events. This event was followed up by a series of events during museum opening hours. These events were designed to test the installations under 'real world' conditions with museum visitors. Around 150 people used the installations at these events. The primary method of data collection at both events was observation coupled with informal discussion and questioning. Participants were also invited to complete evaluation forms on which they could describe their response to the installations. In total, the installations were staged four times for approximately four hours at a time.

3.5 The Installations

Whispering Graffiti

This installation was designed for a smaller unlit cell. The size of the cell (approximately 2m by 4m) and limited access to electrical power and data connection made this space particularly challenging to work in. The cells have several instances of mark-making by the inmates themselves. In some places the representations in this graffiti are readily recognisable; a hunting scene, a sailing boat, and in one cell what looks like the prison itself (see figure 6).

The goal of this installation was to fuse the physical environment of the cell with digital media to create a hybrid analogue-digital immersive experience. Museum visitors entered a dark cell and looked for graffiti using a torch. When a graffito was illuminated a sound would be played from its direction. The experience featured no digital graphics. Sounds varied but consisted largely of voice performances by museum staff including costumed

Fig. 5. Left: Wayfinding inside York Castle Museum, a dark gaol corridor with cells off to each side. Photograph by N.Smith [Public Domain]. Right: The doorway of a cell in York Castle Museum gaol. Photograph by N.Smith [Public Domain].

interpreters and other front of house staff who were intimate with inmates' biographies. Scripting was undertaken in conjunction with the performers during a creative writing and performance workshop in which museum staff were encouraged to produce dramatic responses to graffiti based upon archival evidence and their own working knowledge of the space. Dramatic responses varied from descriptive 'diary entry' style monologues explaining the creation of a graffito through to emotive performances of disjointed inner monologues of prisoners. These audio performances represented a valuable personal and creative response to the museum by people who are very familiar with the space and with the interpretation of the space. The performances were very powerful and were, unsurprisingly given the professions of those producing them, very skilfully written and produced. The monologues reflected the findings of the workshops by focusing on stories of those who were imprisoned for crimes which today have either been decriminalised or would be deemed extremely mild offences. This decision was taken both in order to emphasise significant shifts in attitudes towards crimiminal justice but also to enable audiences to relate to the subjects of the stories without having to confront criminal acts which may be upsetting. The experience had a strong performative dimension with museum visitors encouraged to occupy and move within the space in order to trigger the experience. The 'game dynamic' of this experience emphasised physical exploration of an historic space and discovery of graffiti. It was designed to encouraged museum visitors to focus their attention on elements of the built environment for extended periods of time and to look at the fine details of the space. Whispering Graffiti was implemented using an HTC Vive VR system to track the movement of

Fig. 6. Clockwise, from top left: Marking making in the gaol cells at York Castle Museum. An ornate bird, the gaol itself, hunting dog, architectural detail. Photograph by N.Smith [Public Domain].

the torch (a modified hardware assembly containing a torch and an HTC Vive controller) through the space. The experience was implemented within Unity with users able to activate audio files by pointing the HTC Vive Controller at an audio source aligned with the graffiti in the room. Pointing at an audio source would cause a sound to quickly 'fade in' while moving the controller away would cause it to quickly 'fade out' again. Directional sounds were produced using a set of surround sound speakers hidden within the room. The experience was powered by a PC placed outside of the room.

Evaluation of Whispering Graffiti

This experience was intended as an experiment in (a) the development of new media forms (b) the use of sound to create location specific and highly interactive immersive experiences and (c) the use of an historic space as an integral component of an immersive experience. One of the steering objectives provided by York Museums Trust Management was to consider ways to increase 'dwell time' within the cells because they fall at the end of the route through the museum and as such, visitors spend comparatively little time in this part of the museum. Our observation activities, carried out at the beginning of the project, had noted that, apart from the larger rooms with benches and digital exhibits, most visitors would spend only a few seconds looking through the door of many of the cells, not crossing the threshold unless some interpretation was spotted. Whispering Graffiti was

successful in the goal of improving time spent in the space. Dwell time of groups within the installation averaged 4-5 minutes. This is a substantial period for visitors to spend in a single small room with no interpretation or artefacts on display.

Whispering Graffiti used a game dynamic which foregrounded communal discovery. Groups would enter the room together and collaborate to discover graffiti and access audio content triggered by shining a torch onto the prisoner created graffiti etched onto the walls. Despite the technical possibility of two handsets being used simultaneously, all groups used only one handset. The nature of the task which groups were being asked to perform and the fact that groups chose to collaborate rather than taking turns created many opportunities for cooperation and communication. All groups testing the experience were extremely social and conversational, guiding and helping the person holding the handset and discussing the different graffiti and audio performances. People also used the digital experience as a jumping off point to engage with the building in creative ways. Many groups touched the graffiti and used the torch to create strong raking light across the surface. The beam of the torch being the only light source provided a sense of focus. Once discovered, people studied the graffiti in detail. Users also developed an intimacy with the room itself. By turning off the light in the room the space immediately became extremely dark due to a lack of ambient light, similar to the light levels that a resident would have experienced during incarceration. The use of torches in the very dark room created a dramatic lighting effect, controlled entirely by the user and served as a demonstration of the fact that the cells would have been very dark places prior to the introduction of electric lighting. While not digital, the experience of being in a dark cell with a torch resonated with participants. Participants regularly remarked on the contrast between this space and the brightly lit galleries and corridors of the rest of the museum. Observation had demonstrated that this contrast was often missed as visitors walked past the darkened rooms to get to the gift shop and café situated at the end of the museum's walking loop.

The interplay between darkness and light in this experience was mentioned in some way by every group and in every feedback form. This was a by-product of the use of torches within the installation and the need to ensure that the installation acted as a springboard for users to interact with the building in intellectual and physical ways which are not standard within a museum. We also observed an emotional response to the building and to the audio performances. Many of the groups commented on the extent to which the audio performances humanised the space and enabled them to imagine the people that had been imprisoned there. After taking part in the experience, users discussed fine details of the room which were related to, and unrelated to, the graffiti. Memories of the experience were emotive and personal: these included reflections on how the room would have been lit, whether people would have been able to sleep in the room, where they would have laid, and what it would have felt like to attempt to sleep there.

Whispering Graffiti was the preferred installation out of the two according to feedback sheets collected from visitors, with 50 percent of the 150 participants identifying this as their favourite (as opposed to 31 percent for A Hidden World). In the feedback sheets 70 percent of users proposed alternative approaches to the interpretation of historic spaces using immersive media and several users questioned why the prison space could not be used as a gallery for experimental media experiences. Involvement of front of house staff in the creation of the installation was felt to be very successful. The quality of the monologues and the quality of the performances was remarked upon by more than 20percent of participants. This demonstrates the potential of the production of immersive experiences and interactive media to catalyse creative practice of other kinds and to draw upon existing skill sets present within organisations. The installations were site specific and designed to work well for the low audience numbers who would ordinarily visit the cells. However, the presence of the installation within the small cell attracted attention and encouraged people to wait outside the cell in a confined corridor. This was not a problem within the context of an event but would be problematic if the installations were rolled out as a permanent fixture within the museum. The team ran a special event during opening hours to test the impact that the set up would have on the normal flow of visitors through the space. As an unanticipated interactive experience in the cells, it

was popular. Half of visitors passing the cell stopped to take part in the activity and most of these had to wait a few minutes until the handsets were free to use. Further user testing would be required to better understand how visitor behaviour would be affected and how these installations might be designed to improve the flow of visitors through this space.

A Hidden World

This installation was motivated by the desire to explore the inner lives and memories of prisoners at York Castle Museum. The personalities of individual prisoners have been invoked in previous installations at York Castle Museum with films of actors performing as prisoners projected into the prison cells. The intention of A Hidden World was to utilise immersive media to enable people to experience and respond to the contemplative inner life of prisoners and to introduce a human presence into the cells without explicitly representing the prisoners. Our installation used an augmented reality experience running on a 12.9" Apple iPad Pro. Simultaneous Localisation and Mapping (SLAM) tracking was used to overlay 3D models onto features present within a prison cell. Surround sound speakers were placed within the space which provided an immersive soundscape which changed as the user moved around the space. The different scenes, discussed below, were triggered by the user picking up a representative object placed upon a large barrel in the centre of one of the larger cells (see figure 7).

Fig. 7. Left: Museum visitors use the AR interactive with team member, Anthony Masington. Photograph by N.Smith [Public Domain]. Right: Anthony Masinton demonstrates the AR in the gaol cell. Photograph by N.Smith [Public Domain].

The intention of the experience was to blend the real and the virtual in subtle and unexpected ways and to introduce elements from the lives of 18th Century prisoners into the cell. The museum visitor uses the iPad as a

window onto this fictional world, as though they can observe and temporarily inhabit the memories of prisoners. Each of these scenes was fragmentary, introducing significant elements from fictional historical worlds into the physical environment but never totally obscuring the prison cell. This fragmentary juxtaposition of the physical and virtual was key to the design, as a space within which meaningful authenticity could be experienced. We were interested in how people would reconcile these two experiences and how the virtual environments would impact people's perceptions of the prison space.

Three scenes were recreated which referenced specifically or generally the lives of 18th Century prisoners at York Castle: a ship scene, a pub scene and a tenter yard. The first scene placed the user onto the deck of a late 18th Century merchant ship. Archival evidence and the ship graffiti present throughout the prison attest to the imprisonment of former sailors and, perhaps, to the fact that prisoners might have spent time within the cells reflecting on memories of lives spent at sea. The trigger for this experience was a large conch shell of a warm water type non-native to Britain. Shells were commonly collected during this period and were highly prized [33]. The shell was chosen as a trigger because of the extent to which it would have been remarkable and memorable to a working-class 18th Century European. It is not a symbol of working life (we discussed the use of a sailor's tool such as a caulking iron or holystone) but a symbol of personal discovery with the context of the early days of European Imperial expansion. The scene itself placed the viewer on the quarterdeck of a becalmed ship; the rear wall of the cell was overlaid with the wall of the aft cabin of a ship and the other walls were overlaid with a wide view of the ocean. No contextual information was provided: this was intended to be a reflective and contemplative experience. The confined environment of the cell stood in dramatic contrast to the open expansive views afforded by life on an oceangoing ship (see figure 8). The scene was built around this dramatic contemplative moment.

The second scene depicted the inside of a pub (see figure 9). Pub furniture was introduced into the room and the barred prison walls were replaced with windows and doors showing views across the Yorkshire dales. The scene was triggered by the user picking up an 18th or early 19th century pewter tankard. The aim with this scene was to convert the small prison cell into the room of an 18th century inn or pub. Having triggered the scene, the user is left holding a tankard stood next to a large barrel. The sounds of gentle conversation surround them, and they can see views across the dales of West Yorkshire. This scene was inspired by the story of the Cragg Vale Coiners (Brewer and Styles, 1980) but rather than emphasising the dark or dramatic aspects of this story the intention was to show a more or less domestic scene from life in 18th Century West Yorkshire.

The final scene depicted a tenter yard, the open space in which sheets of cotton would be stretched and dried during the cotton manufacturing process. This experience was inspired by archival evidence of prisoners who had been arrested for stealing fabric by cutting it out of the large wooden tenters (the frames used to stretch the fabric). This experience overlaid the yard itself onto the room. All of the cell walls were obscured by tenters arranged into a maze through which the museum visitor could move. As the visitor moved through the labyrinth the fabric sheets begin to disappear from the frames, revealing information about the penalties for theft during 18th Century. In contrast to the ship experience the tenter yard was not purely dramatic but contained some didactic textual elements. Unlike the ship scene or the pub scene it was also game-like, encouraging the user to move through the space (see figure 10).

Evaluation of A Hidden World

As with Whispering Graffiti, this installation was designed to explore the potential of immersive media to catalyse new uses of and interactions with historic environments. In this case, the strategy was different with the cell used as a backdrop overlaid by augmented reality (AR) visualisations of historic places. The goal of these scenes was to use immersive media to bring fictional environments into the prison cell and to utilise an empty cell as a venue for immersive historical storytelling. Several settings were created, to encourage visitors to respond creatively to these fictional historic spaces and to understand the interplay between the immersive digital narratives and the physical environment in visitors' perceptions and uses of the space.

Visitor behaviours in the installation were diverse, with groups reacting differently to the installation and moving differently around the space, often in unanticipated ways, which challenged the alignment of the 3D scenes in the AR. Unlike Whispering Graffiti there was more apparent anxiety amongst users about how the experience worked or what they were supposed to do. The technology used for Hidden World was more visible than with Whispering Graffiti. Instead of a torch, the device for interaction was a combination of an artefact that triggered content on a tablet. All users required an introduction to the experience and over half needed guidance when first using the setup. The idea of holding the iPad up in front so that a group could see the AR content was not always instinctive and some groups, particularly those groups with more than 3 members, struggled with this. People were sometimes unsure where in the room to stand in order to get the best view prompting a lot of shifting from place to place. Dwell time on this activity was longer, but much of this was spent getting familiar with the technology.

The essential idea of the project, to overlay landscapes and environments onto the prison cell, was successful. Users responded particularly positively to two aspects of the experience. The first was the introduction of expansive landscapes into the otherwise confined environment of the prison cell. Users had noted preference for the view from the deck of a ship and the contrast between being within a prison cell and being on that deck. The contrast in the scale of these experiences and the possibility of bringing large expansive spaces into a confined environment seemed to be extremely compelling to users. This is reinforced in the comment cards, with almost 30 percent of responses explicitly referencing the transformation of space using AR as being one of the standout features of the exhibition. The second was the introduction of large physical objects into the space using AR. The presence of a large working loom into the cell at the end of the tenter yard scene was remarked upon in 20 percent of all comment cards and was discussed widely at the event as being a standout moment.

Observation of visitor behaviour indicated that users spent the majority of their time looking at the iPad and, compared to Whispering Graffiti, spent very little time looking at the room itself. Post-visit comments indicated that participants had not noticed details in the room, unlike the Whispering Graffiti cell. As such, this experience was less successful in providing a 'blended' experience within which visitor attention shifted between the cell itself and the AR content. The artefacts used as triggers were a very popular feature of the installation. Users spent on average 2-3 minutes handling and selecting an object from the barrel before committing to a scene. Every group retained their chosen object for the duration of the experience despite being advised that they did not need to do so. All groups discussed these objects and showed them to each other. The objects were not mentioned extensively on the evaluation cards, but they seemed to play an important role in people's use of the experience, and they were discussed unprompted by the researchers and museum staff who were facilitating the experiences by all visitors who took part. In common with Whispering Graffiti, the central importance of physical objects to visitor experiences highlights the potential for immersive experiences to act as a medium to enable, encourage or support object handling and tactile experiences of material culture. Further work is needed to consider how these tactile dimensions can be designed into immersive experiences for museums and this work should reflect existing curatorial expertise in object handling [6][7].

There was no sign that users struggled to cope with these modes of communication and storytelling. There was little reflection in the comments collected, however, on the lives of the people represented by the scenes, which were based on real stories of prisoners. No users either during the event or in the comment cards commented negatively on the fragmentary, partial or uncontextualized nature of the stories presented and there were no signs that users were struggling to make sense of what they were seeing. While in no way definitive, this provides positive evidence for the importance of staging as a means of framing people's experiences of different genres within heritage. The fictional nature of the experience was made clear to users, as was the premise that these experiences were stylised representations based upon the real lives of specific prisoners.

4 ANALYSIS AND CONCLUSIONS

The work described here added to our understanding of the use of immersive media within museums in a number of ways. In the first instance, we were able to experiment with new ways of deploying immersive experiences in an attempt to mediate relationships with material culture and built environments. These creative experiments built on our previous work in the VikingVR project and taken as a whole allow some insights into how these technologies might be more effectively used in the future. This part of our work has led to a number of new creative directions which might be further developed by others working and conducting research in this sector. The focus within our work on reflexive and experimental forms of co-design allowed us to better understand the design process and to develop new forms of digital design practice which link museums to local digital and creative economies in sustainable ways. We will address these two sets of conclusions below.

4.1 New Creative Directions for Immersive Media and Museums

The Social Museum: One of the most significant observations made both within this project and within the Viking VR project which preceded it [30] is the extent to which immersive experiences can be social in nature. The installations described here catalysed a wide range of behaviour but in both cases inspired collaborative play, interpretation and exploration of both the digital media, material culture and historic interiors. Visitors were influenced by the presence of other users and tended to see the installations as natural opportunities for creative collaboration both within and beyond their immediate groups. Users were able to simultaneously negotiate their physical, sensory and social context while also engaging in the use of digital immersive media. There was considerable blurring between these different 'realities' with people actively collaborating and playing with the digital and physical elements of the installation at the same time. This runs contrary to interpretations of immersive experiences as being necessarily isolating or individual. Their inherently social nature means that museums are ideal venues for new and experimental forms of immersive media which recognise the potential of these technologies to catalyse new forms of social interaction. This may include multi-user experiences and multi-player games (as feature in many existing VR/AR games) but perhaps more excitingly it may also include novel experiences which are designed to alter or enhance social interactions between museum visitors within the museum space. The use of immersive media to create opportunities for collaboration and interaction between museum visitors has the potential to allow museums to further develop their role as community hubs and centres for social engagement. These playful and collaborative dimensions of the installations arose directly from the collaborative design workshops and from our observations of exhibition design and demonstrate the potential of museums to contribute to the development of new forms of digital experience both within and outwith the heritage sector.

Interfaces with the Past: New technologies have very often been presented as a prominent feature of digital installations within museums. In a sense this is entirely understandable with museums playing an important role in providing opportunities for access to new technologies. Our research as found that discrete interfaces which do not foreground the technological infrastructure of the installation can be very effective and potentially enhance accessibility. The use within VikingVR of bespoke wooden VR headsets and of digital 'torches' within the Whispering Graffiti installation were both highly effective at blending the digital into the physical in subtle ways. These interfaces created a very low barrier to use (by being analogous to non-digital technologies and by concealing their technological nature) and, most importantly, provided a range of unanticipated opportunities for social performance, play and improvisation. Conversely, the Hidden Worlds installation which was much more explicitly technological and which required moderately skilled use of an iPad caused a degree of hesitancy and reticence on the part of the audience. Based upon interviews and observation it is our belief that the introduction of recognisable technology disrupted the 'flow' of the museum visit and caused users to question what was expected

of them in that context. This conclusion is still anecdotal but we encourage further work to be undertaken in this area.

The Immersive Museum: In contrast to the VikingVR installation, for which took place within a staged white cube gallery space [30], each installation produced for this project worked in dialogue with an historic interior. Some of these interplays were deliberately incorporated into the design while others became clear only during use. In the case of Whispering Graffiti the digital component was light touch, with all visual elements of the immersive experience being provided by the interplay between a darkened room and a torch. Without the unique setting this installation would not have been possible and, perhaps more importantly, it would never have been imagined. Whispering Graffiti was entirely site specific, born out of the particular space within which it was designed to be experienced. This aspect of the research project could be replicated through the design of installations that use the space as inspiration for the interface as well as the content. In this way, this project provides a demonstration of the unique position occupied by the museum. Historical spaces are immersive, they are compelling and they have stories to tell. Our installations acknowledged this, respecting the historic building as a conduit which enables a feeling of direct connection to the past to be established. This potential can be activated by digital media, as described above we found this to be particularly effective when technology was used discretely and opportunities for exploration and play were clear.

In both cases, the research demonstrated that museums housed within historic buildings can be particularly well suited to the development of new media forms. Interactive and immersive media have often been used within archaeology and museums as a means of representing the past [13][8][28][34]. This project demonstrated that as well as being used for depiction or representation, interactive and immersive media can also be used to mediate and to guide physical, intellectual and emotional engagements with the past. Each of the Within the Walls of York Gaol experiences enabled a different form of interaction with material culture and built environments which would not have been possible using conventional media. Because the experiences depend to such a high degree on the interplay between digital media and particular objects and places, they are site specific and would not work if deployed in a different setting. Rather than being a weakness of the work we feel that the strength and importance of these installations lays in their ability to create a unique and highly personal interaction with archaeological material. The establishment and cultivation of personal relationships with the past is integral to wellbeing [5] [15]. Participating in the creation of interpretive digital media gives people a stake in the finished installation and provides a mechanism for a diverse community (based inside and outside of participating organisations) to participate in historic interpretation. Both Within the Walls installations provided museum visitors with an opportunity to interact with historic buildings in a new way and to develop a personal relationship with and personal understanding of these spaces. In addition to the designed digital interaction, immersive and interactive media provided tacit permission to behave differently, to dwell actively within a space and to explore it. This potential has been identified but by no means fully explored. This represents an important new research direction for researchers in this field.

4.2 Collaborative Design Futures for Immersive Media and Museums

This paper reflects upon the process of design and making and also explores the broader implications for this kind of work on the future of research and design practice within museums and universities. The emergence of 'mixed reality' technologies and the rapid convergence of games and interactive media have created new opportunities for storytelling. However, immersive media are still in a state of flux. Identification and exploitation of these opportunities represents a major challenge particularly to those working outside of the media and technology industries. A goal of the VikingVR project was to develop new creative models to enable researchers and practitioners without specialisms in digital media to participate meaningfully in the development of media projects alongside specialists in digital media research and development. Within the Walls built on that work, to

evaluate the potential for creative models between museum professionals and university researchers. Access to advanced digital media skills for exhibition and experience design has been negotiated in a number of ways and with differing levels of success. Positive results have emerged from University-Museum digital partnerships [21][26][31] but digitally orientated collaborations form a small subset of this type of collaborative project [5]. More usually, access to digital expertise has been brokered and negotiated through a process of commissioning, through which museums have worked with commercial providers in order to secure the expertise necessary to produce 'cutting edge' digital content. The organisational skills deficits mentioned above coupled with an increasing scarcity of time and resources within the museum sector mean that opportunities for skills sharing and collaborative design are often limited within this kind of project, and relationships formed in this way are not always as innovative, productive, creative or sustainable as they have the capacity to be [24]. Current commissioning models, inextricably tied in with management decision-making and funding processes, can have the effect of preventing curatorial and pedagogic input from the museum into digital projects [3][16]. It can also prevent the kinds of digital skills which might enable more productive input into future digital project design from taking root within museum organisations [24].

Our work attempted to address some of these challenges through the development of experimental and reflexive design models based on a mix of focussed event-based design sessions and long-term participation by digital designers in extant design and decision-making structures within the museum. We found that the focussed workshops provided excellent opportunities for ideas generation, but that co-working coupled with opportunities for participation and observation provided the basis for sustainable relationships between researchers, museum staff and creative practitioners. By providing space within the museum building over the duration of the project the museum provided an opportunity for gentle and reflective design practices which stand in contrast to the intensive and often competitive event based design workshops. Our work demonstrates that the museum has an important, if largely unrealised, role to play within the digital creative economy. Within their spheres of operation regional museums are major cultural venues and major cultural commissioners. They also have the capacity inspire and inform practice at a national or even global level [10] [11]. They have large and diverse audiences and assets which are not easily accessible to or well understood by the majority of university researchers and small creative sector companies. We propose that through practice led collaborative research it is possible to configure projects which enable participants to harness these creative opportunities and to develop media forms and innovative digital experiences which will transform perceptions of immersive media and place the cultural heritage sector at the forefront of regional creative economies.

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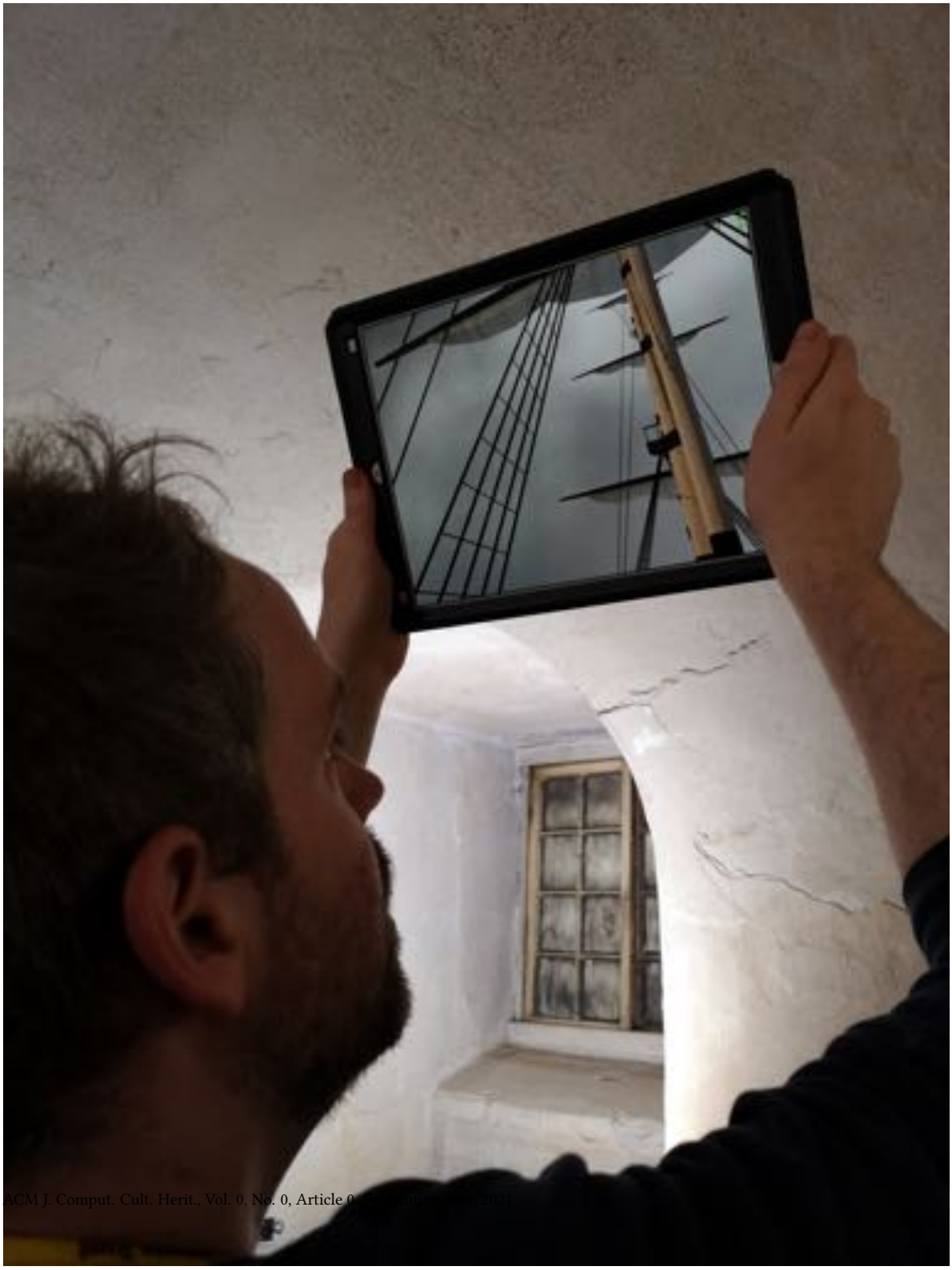

Fig. 8. Gareth Beale holds up a tablet inside the gaol cell, looking up at the masts of a tall ship. Photograph by N.Smith [Public Domain].

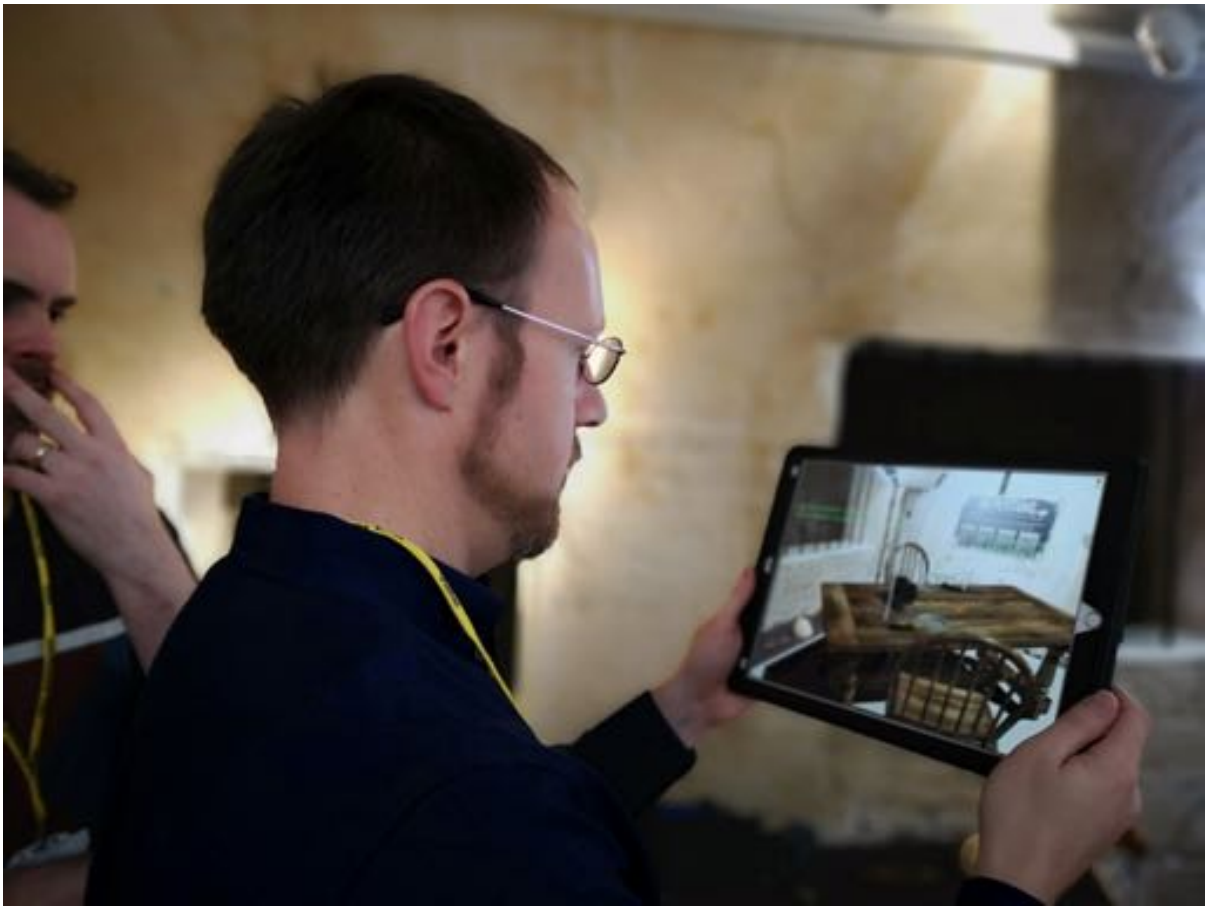

Fig. 9. Anthony Masington holds a tablet inside the gaol cell, looking down at a pub table and chairs. Photograph by N.Smith [Public Domain].

Fig. 10. Anthony Masington holds a tablet up to show a group of visitors inside the gaol cell, one of the AR scenes. Photograph by N.Smith [Public Domain].