
Creative Technologies Project: Research Report

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Abstract

This report investigates Augmented Reality (AR) and how it can be used in the field of locative media to layer the physical environment with new context. The aim of the document is to assess theory, existing platforms and further explore the idea of using such technology to enrich the space near Bristol's floating harbour. The chosen space is addressed through ethnographic methods as well as assessing potential user desires within the space. Technical aspects are also presented that outline using 'app-less' Web-AR.

Introduction

Historically, stories that have been told about a space have been revealed through the erection of plaques or monuments (Farman, 2012). Referred to as 'locative media', the term describes the interplay of media in an existing physical location and the attempt to link personal social interaction with a place and often, technology. Such projects can reveal something new or inform the user about aspects of the space. With the prominence of mobile devices, the ability to access more information about almost any topic within these spaces has increased. Which raises a question shared by Farman (2012): how can media elements affect our perception of spaces?

Augmented Reality (AR) is one such technology that can blur the boundaries between the physical and virtual spaces. AR applications utilise the built-in camera of a user's device to capture the physical space, then superimpose content (usually in 3D) on to the live footage in real-time. AR has many conceivable applications in various fields. For example, in culture or education AR can enhance learning further than the traditional approach (Pan et al., 2006). *Civilisations* (BBC, 2018) uses marker-less¹ AR and allows users to explore and interact with cultural artefacts with the aim to make learning about art and history more accessible (Appendix.B). In addition, *Streetmuseum: Londinium* (Thumbspark, 2018) uses the real space where artefacts were found to enforce greater context. This aligns with De Lange's (2010) understanding that states locative media induces us to reflect on ourselves in spatial terms. Virtual environments such as this that are culturally embedded can be classified as virtual heritage (VH) (Norsyafawati, 2016).

A commonality that these AR applications share is the requirement to be downloaded, from an app-store, by the user. Alternatively, Web-AR promises users with access to the internet to experience AR in their browser. Although it's in its infancy and less powerful than the leading SDK - Vuforia (2018) which uses a combination of plane and image detection, there are already supported libraries and frameworks. AR.js (Etienne, 2018) is an open source JavaScript library which allows for the development of html Web pages to include AR content (ibid).

¹ Does not depend on physical markers to trigger augmentation.

Research Methods

Research for this project was conducted in various areas and include field research, technical research (through rapid prototyping) and initial desk research to provide context to the space (Appendix.D).

First, short semi-structured interviews with members of the public near the harbourside were conducted. The intent was to establish how people imagine using AR with their mobile devices within the environment around them. What would they expect to see and how would they expect to use it? What preferences exist with content types or media that could be overlaid in the space? The semi-structured nature allowed for natural reaction to interesting points raised by participants while remaining on topic. This method borrowed from 'Design Probes' (Gaver et al., 1999) provides insights into multiple perceptions from potential end-users.

A longer thirty-minute interview with a local expert about the space and its use was produced, along with field sketches and photographs which served to visualise the space after visiting. In addition, observations were amassed by using the 'participant observer' method that seeks to be unobtrusive (Blomberg, 2003). The observations were used to survey the spatial usage of the site. This method is usually sustained over a longer period in an attempt to gain a deeper understanding of people's perceptions (ibid). The short-interviews could have been furthered into a better ethnographic study here, by asking people about their thoughts and emotions of the area.

Findings

The process of thematic refinement (Braun & Clarke,

2006) was used to analyse the short interviews and identify patterns or overlaps in participant responses. As a result, the following themes emerged (figure.1):

- 1.) Space – how the experience is seen to mix with the physical location,
- 2.) User – participants understanding of the technology,
- 3.) Media – preferences of what media types could be used and
- 4.) Content – what people may learn, do or experience.

See appendix.E for transcripts.



Figure.1 Themes that emerged from thematic analysis.

It's clear from the responses that the participants believed using AR could help contextualise the location, adding another layer of information to the space. Participant-B stated that it would add context to the space that you otherwise wouldn't get. Participant-A

said they often liked learning about new places when they go on holiday and that it made you 'appreciate it more'. What's more, every participant implied that content should be about the history of the immediate location. Furthermore, preferences for media types varied, but what emerged was the predilection for visual media, with participant-A stating that 'text can be boring'. The use of sound wasn't seen as a leading element, but rather as an addition. Participant-A and C said they would be frustrated if they weren't carrying headphones.

The understanding amongst participants of AR could have been a limiting factor in these interviews. The older demographic couldn't imagine the possibility to interact with augmented media, which came as a useful surprise. As an improvement, a demo could have been shown to prompt understanding. But everyone understood how to approach a marker and likened it to using *Snapchat* (2018) or QR codes. Reluctantly, the fact that you don't need to download an app resonated well too, but as pointed out by Participant C, people may not want to use up data roaming. Although these interviews were small scale, they've raised interesting points that will inform future design decisions.

Ethnographic Findings

This project will be competing with other media's that inform on the harbourside. To gain a better understanding of the space, an interview with a local from the Underfall Boatyard (location in figure.2) who is referred to as 'the expert' took place, see appendix.F for transcript. He explained how Underfall is a multi-faceted place and that people use it in different ways. For example, locals use it as a shortcut, people walk through for leisure, some may visit the coffee shop. But Underfall is also a working place, which many people don't realise. This is a useful insight, as during the short user-based interviews participants stated that tourists would be the predominant user of an AR

application about the space. This differs to the expert's opinion which states that initially, it will be locals that would want to use the system.

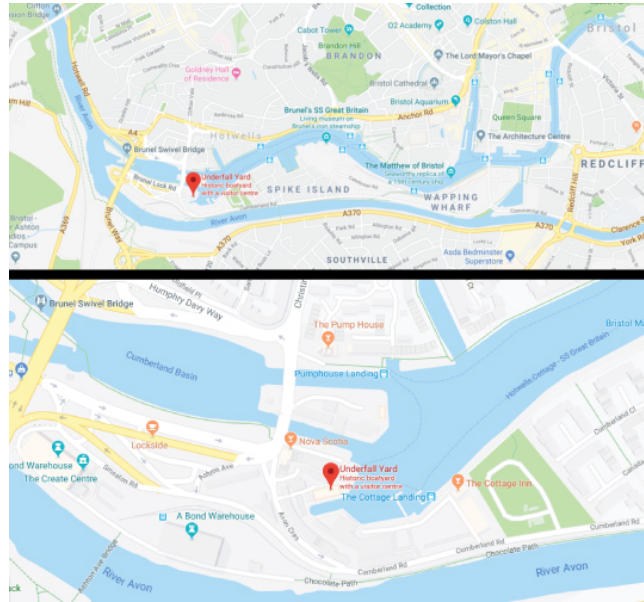


Figure.2 Map showing the location of Underfall Boatyard on Bristol's floating harbour.

Source: <https://www.google.co.uk/maps>

With regards to my project, the expert liked the idea of not having to download an app and that AR could provide a better understanding of the space. As discussed, users take different things from the space and perhaps don't understand the full picture. There's an element of mystery to Underfall, it's a working place which means you can't have heritage signs affixed everywhere. AR could supplement this by being an unobtrusive alternative.

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By entering the Underfall section, it feels like a detour from the route that hugs the harbour. Sketch 1 (Appendix.H) shows the path and possible points of interests (POI). By observing the area around Underfall, you quickly notice how much quieter it is in relation to the other end of the harbour. As people pass through 'inner-underfall' (sketch 2, Appendix.H), people tend to slow. Some people stop to try and peer into the workshop, others glance around at the boats and carpentry as they pass. This shows there is an interest in the space, but there isn't much interpretation of the information on offer. As mentioned by the expert (Appendix.F) it's a lived-in place, and this can be seen in the environment.

Technical Findings

For prototyping purposes, AR.js and A-Frame (2018) were used with 'pattern' markers that help guide the camera pose estimation process (Shetty et al., 2006). Whilst attempting to create an original marker, it became clear that they have strict rules (Appendix.G). A-Frame works like most 3D technologies, you begin by defining a scene, adding and building assets and then adding a camera so the viewer can see the scene (figure.3). Through the experimentation of two prototypes, first, a cube with '<a-box>' node was augmented (figure.4), and the positioning and scale were explored. Second, a 'plane' with an image material applied and rotated above the marker (figure.5).

```
<a-scene>
  <a-marker></a-marker>
  <a-assets></a-assets>
  <a-camera></a-camera>
</a-scene>
```

Figure.3 Simple A-Frame structure to a scene.



Figure.4 Augmenting a 3D cube.



Figure.5 Augmenting a photograph using the <a-plane> module and applying an asset material.

These prototypes weren't tested on a mobile device, but a desktop webcam as there needed to be an SSL certificate on the server. Therefore, the camera remained still, and the markers moved, this will need to do the opposite by implementing '<a-marker-camera>' instead of '<a-camera>' nodes. Next, these prototypes will be improved by adding interaction that could announce more media or UI elements. The addition of animations could be visually striking and add to the experience, so further study into libraries such as THREE.js (2018) will be beneficial. Supplementary to all the above research is a basic user journey (Figure.6) which outlines the steps a user may take with the proposed Web-AR experience.

tied to its history. Using Underfall as a potential POI, the space itself has a range of audiences that include locals and tourists. But it's more likely that younger people will engage with this novel technology. The space should be supplemented with more visual media and although participants weren't entirely convinced by the use of audio, there is a case to consider the temporal space and use audio as a narrative bridge (Farman, 2014) between markers. Finally, there are further challenges that need to be addressed. Usability and the design of the UI are important factors that have yet to be properly explored, as well as technical aspects of storing data.

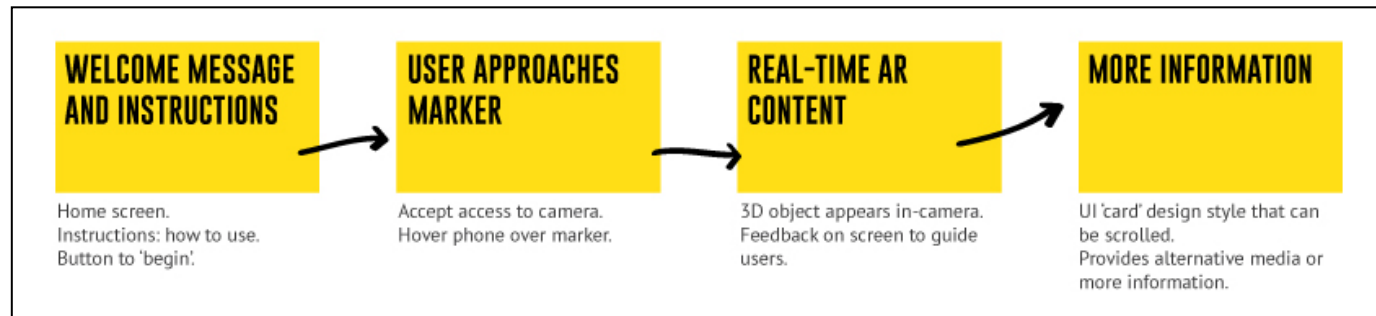


Figure.6 Basic user journey.

Conclusion

This report has considered the concepts of locative media and using AR as a means to explore a sense of place. Potential users were probed to help reveal a desired artefact that will enrich the space. What's become clear is the acknowledgement from participants that AR could provide insightful depth to a place if it is

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Appendices

Appendix A – Project Log

Name: Arron Taylor-Peter Student number: 14041505	Project (working) title: An Alternative Reality: Augmenting Personal Storytelling to Gain a Sense of Place
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Week	Task(s)	Outcomes	Takeaways
Sept 3-9 2018	Investigate the current uses of AR. What are other people doing? Is there a gap in the market?	There are many applications, but quality varies. Games and education seem to be the biggest sector. But there isn't depth to many of these, they're just entertainment.	Could I link AR to location more? Could I provide more meaning to a space with AR?
Sept 10-16 2018	Decide on an idea – what should my AR experience be about?	Museums seemed like an obvious choice, but I'm interested in telling alternative stories in a space. I've chosen the harbourside as my location and focus – due to its deep-rooted history.	Explore storytelling. Look for similar examples. Why will AR be beneficial to this and how could it work?
Sept 17-23 2018	Look at AR benefits/drawbacks, why it is useful? Investigate location-based AR.	AR supplements the physical space, not replace it. Makes things more accessible. Commercial location-based AR often add facts not personal points of view.	My AR could bring communities together. Showing alternative stories.
Sept 24-30 2018	Look at technologies Meet with supervisor.	Watched video tutorials and read documentation. Unity and Vuforia seem to be the mostly used technologies. WebAR is also an option with AR.js, A-Frame and THREE.js – but are these reliable? The AR experience doesn't have to use a printed map, could be signs around the location.	Think about which technology would be best to use and how will it work?
Oct 1-7 2018	Start writing report. Make a project plan that will cover all aspects from research to	Realised I need to do some more academic reading to make more concrete points.	Search library services or Google Scholar using keywords such as 'locative' or 'AR' to find relevant

	development and iterations and testing.		papers or books that could help support my proposal.
Oct 8-14 2018	Finish writing proposal.	Proposal completed.	Next, I will need to prepare research, look at the goals decided in the proposal and make a plan. Start reading the books on the reading list.
Oct 15-21 2018	Read relevant chapters of Mobile Media Storytelling.	There are various useful chapters, but I only dipped into a few that covered design, practice, narratives and memory, history and community. This book is slightly aimed towards telling stories. I think it would be better to read <i>Mobile interface theory: embodied space and locative media</i> , also by Farman.	I should start a glossary of terms. Look into some of the projects referenced in the book. What are the authors doing now?
Oct 22-28 2018	Take <i>Only Expansion</i> locative audio tour by Duncan Speakman. Write-up about the experience.	It made me think about the space and the journey that I wanted to take. I found myself stood still often, to take in the environment and identify where certain sounds came from.	This piece thought about the temporal space more than augmented work I have read about so far. By making the spaces between locations part of the experience it creates one continuous flowing experience. This is something to keep in mind for my project perhaps.
Oct 29 – Nov 4 2018	Academic Research. Competitor Analysis.	Found the term Virtual Heritage (VH). Used the BBC Civilisations AR app. I'm pleasantly surprised with how smooth it was and the use of sound effects made it more immersive. I wrote up strengths and weaknesses.	Find another existing project that uses Web-AR and not an app.
Nov 5-11 2018	Prototype with AR.JS	Found that the tech can be a bit 'buggy'. I used the A-Frame framework as it allowed me to work quickly and try out different scenarios. You need an SSL certificate to use the camera on a live server, I resorted to localhost.	Think about creating my own marker. Instead of a pattern marker, a barcode marker will probably be better. How will THRRE.js integrate?

Nov 12-18 2018	Meet with supervisor. Contact possible organisations that may want to support the project.	Discussed in supervision session what needs to be included in the report. Emails sent to organisations.	Need to contextualise my work by looking at other academic work.
Nov 17-23 2018	Further Reading. Plan Ethnographic Research and create a rough structure of questions to ask.	Semi-structured interviews have been chosen so that I have a rough structure for what I need to find out. Underfall Yard have replied and agreed to an interview.	Underfall could pose as a POI. Plan to carry out observations here and interviews. Need to do some desk research about the area before visiting.
Nov 26 - Dec 2 2018	Interview with Expert at Underfall Boatyard. Conduct User Interviews. Carry out Ethnographic Research in the space. Write-up findings.	Interview lasted 30 mins and I was taken on a tour. What's interesting is the way that the space is used. The potential users are broad, but the space is quite an interesting one as it has old buildings, nice view, boat building and a long history.	People's understanding of AR varied in interviews. I will need to point this out in the report as I should have explained it better. I should have also asked people about their feelings of the space more. Next analyse these findings to identify patterns.
Dec 3-9 2018	Meet with supervisor. Explore creating my own AR marker. Begin writing report.	Discussed what should be in the demo in January and the progress with the report so far. AR markers have strict rules, they must have specific black and greys (not whites) and must be square. I didn't have much success in creating my own as the camera couldn't recognise it.	Although I have most of the content for the report. I need to start writing the final document. Use the 'hiro' default marker for now. I could re-visit this problem in development.
Dec 10-16 2018	Create a simple user journey. Finalise report and tidy appendices.	Research Report Submitted	Next, build on the prototypes for the demo. I need to add interactions and set-up a database to store data.



Fig.1
Settings.



Fig.2 Captions that guide the user.

Appendix B – Competitor Analysis (BBC Civilisations)

I have researched other projects and applications to better inform my design processes but also to determine where my project fits and measures up within the field. Commercially, looking at app-stores, there are a limited amount of AR apps available that refer to heritage or space. There are numerous educational applications or practical AR apps that help you measure or decorate your house, but on the face of it, quality of design varies.

What is it?

An augmented reality app that allows users to view historic artifacts, available on Android and IOS and can be used anywhere. The app was built using Unity and uses marker-less AR to place and render the objects. More information about the project can be found here: <https://www.bbc.co.uk/taster/pilots/civilisations-ar>

Who is it for?

It's intended for everyone and is linked with the content televised on the Civilisations series (2018). It's likely targeted at those who enjoyed the series but also people who are interested in exploring culture.

The goal

Making art and culture in the UK more accessible. By bringing these artefacts to people in their own homes is beneficial to those who can't travel to museums often.

Using the App

When you first open the app you are taken on a proficient tour of how to use it. You are guided by a narrator with a friendly tone and supported by visual

prompts. It politely asks you to find a surface, move the 3D model around, interact with 'hotspots' (more on this later). It also guides you to explore an augmented globe to unlock more artefacts and settings are offered which contains the option to turn sound on or off as well as other options (fig.1).

All audio narration instructions are supported by text subtitles or captions to guide the user on what to do from the beginning (fig.2). But you only hear sound when headphones are plugged in. There is no prompt for this, so it may not be immediately known that sound is available. The option to skip is always present on screen, giving the user control of the system (NNGGroup, 2005).



Fig.3 Hotspots.

The user can rotate and scale the 3D objects. This is accompanied with sound effects when you interact with it. You can interact with buttons that appear on the 3D model referred to in this application as 'hotspot' (fig.3). These buttons present further media like audio clips about the artefact or the ability to 'x-ray' a model.

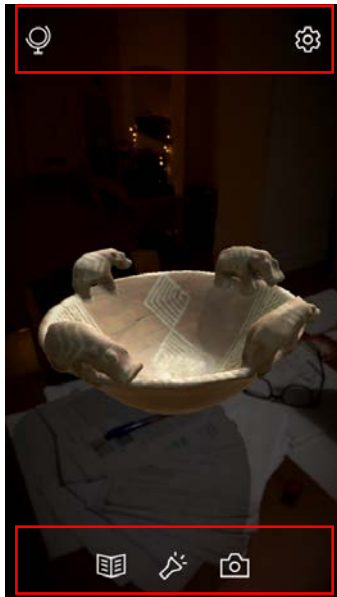


Fig.4 AR screen showing UI navigation.

The UI is clean and simple and isn't a distracting element combined with the AR content. Navigation is split and displayed on two sections of the screen (fig.4). At the bottom of the screen are three icons. The first is a camera for taking photos with the AR elements in the scene. The second is a torch which represents 'spotlights' that provide users with more information about the artefact. The third is an icon of a book and once clicked presents text about the artefact which can be scrolled and exited back to the main screen by clicking the small 'x' (fig.5). In each top corner are two further icons, one of a gear which will take users to the settings and the other a globe which allows the user to explore themes and rotate a virtual globe in the physical space, select a point and load it into the space. These navigational elements are clearly positioned around the edges to be as unobtrusive as possible with the AR but also easily accessible. There is no need to break the 'scene' for example by having to navigate to a menu.

Strengths

- Friendly, informative tone.
- Good use of audio to supplement interactions.
- Unobtrusive UI and navigation.
- Ability to rotate and scale 3D models.
- Good use of usability heuristics (NNGroup, 2005) such as feedback, user control and system status.

Weaknesses

- The experience isn't the same without music, a prompt that states that it would be better with headphones should appear at the start.

- Lighting must be right for the plane detection to work properly.
- Not accessible to those with older devices.
- Uses 113mb of phone storage, this is without downloading the assets – which is an option if you don't want to use the internet.

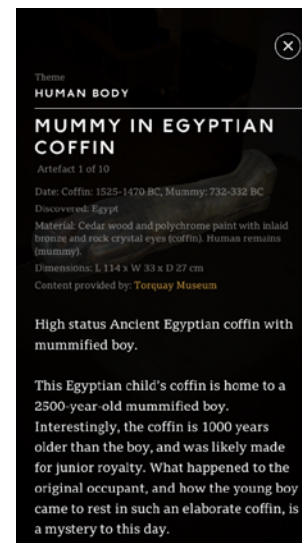


Fig.5 Text about the artifact pop-up.

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Appendix D – Desk Research: Harbourside

22nd November 2018

The harbour is central to the image of Bristol and has a lot of history related to it. This comes as no surprise with numerous museums and cultural organisations dotted along the harbourside. The area contains the MShed Museum which explores stories about the city, Arnolfini Gallery, Watershed, SS Great Britain, Brunel Museum, Underfall Boatyard and other interesting points of interest with their own stories such as the cranes, The Mathew and a decommissioned train track. All of which provide me with plenty of content options for my project. I plan to reach out to some of the organisations listed above to see if they would like to support augmenting a harbourside trail.

My main source of information is from www.bristolfloatingharbour.org.uk. Here are some of my findings:

- The harbour is referred to as the 'floating harbour' locally as the water level is controlled.
- The current location of the harbour was the original cut of the river before it was diverted around what is now known as Spike Island.
- The new cut was cut from Rownham to Totterdown.
- This was done to keep ships afloat when it was a busy port, which ceased as a trading port in 1975.
- The floating harbour is now used for recreation and leisure.

In addition, according to The Bristol Post, in the 1960's the harbour was almost drained in place of a motorway ring-road, the plans were defeated by 6 votes.

<https://www.bristolpost.co.uk/news/bristol-news/fact-checked-another-10-claims-271003>

Notable Projects:

- *Up The Feeder Down The Mouth and Back Again* is a play and a book written about Bristol Docks.
- *Bristol Dockers* is an audio tour from 2018 that combines new and existing oral history interviews with former dockers to make a soundscape that brings their voices back into the city.
<https://www.bristoldockers.co.uk/>
- *Know Your Place Bristol* is a website that allows you to explore Bristol through historic maps, images and linked information.
<http://maps.bristol.gov.uk/kyp/?edition=>
- *Avon Stories* is a project by Sarah Connolly that explores 'the tidal River Avon in Bristol, through podcasts, films, sounds, photography, walking and more, including the occasional blog.'
<https://avonstories.com/about/>

Appendix E – User Interview Transcripts

5 minute interviews near Underfall Yard Car Park.

Participant A

How would you interact with the marker?

I imagine it would be a bit like Snapchat where you use the camera over it and then something comes up.

Describe what would come up.

Like flash up like you've found something and then I guess you would press something to see it. You could scroll to see different things like a video or something.

What sort of information would you see?

History about the harbourside and how it's changed or notable things that have happened there.

What types of media would be best?

Definitely video – I think it's more interesting. Like you could have a video over there, it's completely different in the summer.

Anything else?

Maybe text to explain things but that can be boring.

Is there sound?

I hope so, it's more interesting. Not too much – it would get a bit annoying.

What sort of sounds would you expect?

I don't know, it's always satisfying when you scan something and it makes a lot of noise.

What about narration?

Optional maybe? Because sometimes I like listening, other times I don't and I may not have my headphones. Yeah it could be a bit distracting? You would assume the thing would guide you and it would be a fairly easy thing to interact with.

Why is that important?

Less effort, I'm quite lazy when it comes to technology.

Who would use this?

Tourists? Maybe students that study history. Anyone who has a phone to do it. It's hard to classify because you get people who don't have smart phones but are younger, so who really has a smart phone probably.

How do you think it will affect or change the space that you're in?

I always like to know about the places I go to. Like when I go on holiday I always like to go to historical sites and learning about it all. The interesting things like, you know.. I don't know how to explain it..yeah.. I think it would make the harbourside more interesting and in-depth. Make you appreciate it a bit more maybe.

Will the design be important? How easy is it designed to be used?

I don't know anyone who can be *assed* with complex websites and complex things. Even if you don't know it's there. But you see this thing and it has an instruction or something that's like scan this to find out more. It's like a .. little nugget of information that you didn't know you were going to get that day - that's kinda cool. Like a little treasure hunt.

Participant B

How would you interact with the marker?

So, by scanning it or just by holding the phone over it. You would probably need to have an app or something.

Describe what you would see once you've 'scanned' the marker.

A 3D image of something related to that specific area that you're in or whatever you're looking at.

Would there be other types of media as well as 3D?

Sound effects and music, photographs – I think visually seeing something is better than having music. But it depends where you are and what you're trying to represent.

Could you interact with these things that appear in any way?

Move it around or move your phone around to see different angles of it and seeing what it looks like in the area and the location that you're in.

How would it add to the space that you're in?

Maybe make you think about the historical context a bit better. When you can actually see something in front of you rather than just reading text from your phone.

Why do you think that's better?

It's more immersive? Yeah.

Who do you think would use this?

Very young people, students like yourselves. Or maybe people on one of those Bristol walking tours, that as well. But younger people won't be scared of it they know more about this stuff

Participant C

How would you approach a marker with your phone?

How would you interact with it?

I would use the camera. I would have to get an app would I?

Is that an issue?

Urm. Yeah it is a bit as you don't really have enough data when you're out and about to download an app. It's a bit like QR codes, it was a good idea but you need an app so no one uses it.

So, you would scan the marker like a QR code?

Yes, I would hover over it.

Describe what you will be able to see once you've scanned it. In your phone.

I'd want to see something kinda interesting. Like if you look through it and it projected a boat that used to sit on the harbour and maybe something more with that. Because if you looked through and just saw a boat, I wouldn't have any idea what it was. I would want to know: what is it?

Would you be able to interact with this boat?

I haven't really played around with much AR that you can do that with. It's normally just walk around and look at it yeah.

Okay. You said other information would be good. What other types of media would you like to see?

I guess maybe text on the screen or audio. But with audio you would have to have your headphones with you. Urm so maybe like, if there was audio there should be captions on at the bottom.

So, when you say audio do you mean narration?

That would be nice, but the way I see it is audio over what I'm looking at. It doesn't matter what it is.

What sort of information would it tell you about a space?

If it was a boat, it would tell you what it is and the significance of it. This is why it's a big deal to Bristol, this is why it existed um and maybe what happened to it. I always find that quite interesting.

Why do you find that interesting?

Because they normally sink! Haha. When I walked around SS Great Britain, my favourite bit was all the stories about times it sunk and got dragged back up and stuff like that and if this did that and you could move around it and what not, you could properly visualise it more than a little placard that you usually find on the side. And you could come back to this site again with a friend and say hey this boat used to dock there, and it hit an iceberg.

Who do you think would use this?

Millennials.

Why do you say that? and define millennial as well.

18-32. Because they are the kind of people that get out and about a bit and embraces new of technology. Because if you go older than 32 you wonder into the age where people start to be like I'm not going to download an app for this, I'll just read it in a book. If you're younger than 18, they'd just want Pokemon Go.

So, you mentioned about downloading an app just now.

If this didn't require that, it instead took place in the browser. Do you think that would be better?

Yes, but it would depend on the data usage. Would it suck up as much data as downloading an app would? Would the website require a lot of data roaming?

I don't know if I can answer that. I guess it would use up some yes.

But would it use more than downloading an app? Because that's why I hate downloading an app for it because if I'm on roaming I don't want to waste it. But yeah, it's a lot more convenient if that's what you mean.

Participant D – Expert Short User Based Scenario

Imagine you are using this device (user's phone) and you come across this marker around the harbour side. How would you interact with it?

I imagine I could scan it or photograph it.

Describe what you would be able to see.

I imagine it would be a mixture of information about the location. Maybe an image overlaid on the location, an image from the past.

Would you be able to interact with it?

I wouldn't imagine so with my phone and level of ability with things of that type and a publicly available thing in a space like that. I can't imagine it will be that interactive, perhaps it might. I can't imagine I will be able to choose what I wanted to be told by it, I wouldn't be able to influence what it did.

The system will take you on a path rather than you choosing?

I could choose the order in which I scanned them, I don't imagine it would be that interactive.

Would there be any sound?

There could be, my phone could cope with that and video.

What would the information you see tell you about the space? How would it enhance being there?

It could tell me what was there before, history of that spot. What is around there.

Who do you think would use this?

Well, if.. it was advertised correctly there is a scope for both tourists and locals to use it. But it would have to compete with numerous paper-based, map based, sign-posted walks. Some of which are older than others, some of which is incomplete – it seems. Some of which have been finished and forgotten about. So, it would have to fit in with that mixture. I actually think it would be locals initially. It would be difficult enough if they had to download something to use.

There's an effort on the user's part I guess to want to do it isn't there?

Yep. It would have to be a clear advantage. There are numerous things that you can download – get the app for this -and I don't know about anybody else, but my phone is a year and a half old and I can hardly download anything. If I need to download something to buy a bus ticket, I can end up giving up as I have to remove other apps.

Appendix F – Expert Interview Transcript

This interview lasting thirty minutes covers thoughts, relevant people to talk to and possible content and POI's.

There are different angles I could take this project. Sharing stories, educating about how the area came about or something more leisurely.

If I had to be cynical, I'd say be careful because there does seem there is a lot of things like this type already. We get organisations that produce guided walks on paper that include us. There is a number of them. The key thing is to have a unique selling point.

This won't be an app. You won't have to download anything. It will be completely in the browser, you just need to navigate to a website. Any phone should allow you to do it.

I see, that is good, if I was instructed to just follow a link to a website, this would help me. I would just have to be in that location. Are you trying to cover the whole harbour or just this end? Because we could – and you're very welcome – could give you so much stuff to use in it. We have loads of info about our site and a bit about the Cumberland Basin as well. So, another thing that's interesting is that there are a lot of plans for development down this end, a lot of interest. But it depends content wise, what you're after.

Because there are a fair few of those – listen to the old fuddy and what he has to say. There's enough of that, it is interesting and great but its sort of has been done. Especially, see Bristol Dockers.

At this point I was taken on a little tour to look at potential POI and understand a little about the history

and Underfall's involvement with the harbour. Here are a couple of things that came up:

- People do always love the then and now pictures.
- How long will people want to stand and read text?
- 3D models would be really nice.

Discussion then turned to the accumulator, a large weight that when lifted was once used to generate pressure to open locks etc. It's demonstrated through the week. See Fig. 1.

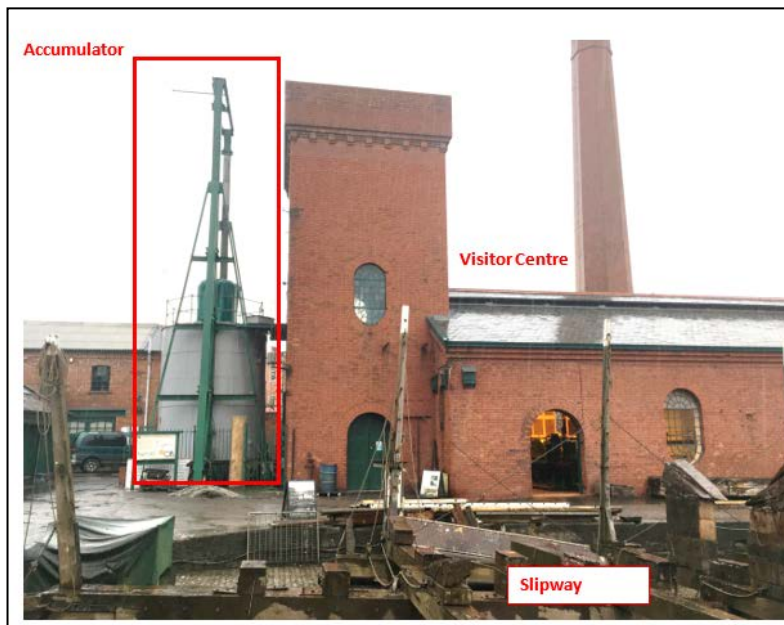


Fig.1 Photograph of Accumulator.

Most people don't even realise

that the entire grey thing lifts up. AR could actually show it up. It would be physically and practically important to us because, there is a cost to doing it twice or three times a week. If someone walking past could use their phones to actually see it going up somehow overlaid. Most people when they see it going up are quite surprised. They just assume it's a big tank and it just sits there. Another thing you may like it.. The Cumberland Basin floods a couple of times a year. And every two weeks they open up sluices, which is a spectacle to see. We're hoping to put together tour for people to see this. And again, unless you've seen it, you might not believe. The slipway is another one, has a lot of history and there isn't always a boat on it.

Is there a distinction between education and information?

In heritage they call it 'interpretation'. The point is 'interpretation' does the object speak for it's self.

Historically information about spaces have always been put on plaques and boards. Where as now everyone has a phone and we can enrich the space.

a working place, we have a sense of character around here, the Victorian buildings, the odd – uneven stones, the puddles, you know it's a lived in place. So actually we have a constant struggle, we want to explain the slipway, but we don't want to have to cement signs in. Your idea is non-obtrusive and contactless. And actually, I did a bit of volunteering with English Heritage. Just to put it into context, if they want to put up a sign like that one I'm talking about. They have to have a full archaeological survey done of the hole the sign is going to go into. The sign cost like 500 quid but the survey would cost a thousand. That's the value of this type of thing. You could have the yard completely

sign free apart from these types of things (referring to markers). It speaks for itself, all you need is the phone.

Do you think this space is missing something?

It's a strange location this. Sometimes people say... because we're not a museum.. although we have the visitors centre.. and people come through and don't really know what it really is.

When I walk through, I just think it's a nice place, but there's an air of mystery.

So that's the point. If we go back to your question.. can AR change your perception.

So let's imagine you were doing it with the suspension bridge. It's a bridge, it's old, it's Brunel, it's beautiful. That's right, it's a basic perception but it's accurate. So AR should change that perception, it could deepen it. But could it shift it?

But a lot of people don't fully know what this place is, partly because we don't have signs, may not have advertised it well enough. So there is a mystery there indeed.

Another thing about this site, you know, we are fully aware why people are here. Yes people come and visit the visitor centre, especially on big events – open doors day or dock heritage.

But we are fully aware that people use it to walk through, to go to work, home, whatever. They use it for leisure, usually doing the full circuit and they might actually call in to the visitor's centre and we also know that a lot of people use it for the coffee shop. So, we're fully aware that we don't want to go full hard with

'heritage, heritage, heritage'. Because we do know it's a working place. Point 2, it's a multi-faceted place, the views, the buildings the slipway, the guys working, dog walking opportunities. It's all those things, so we don't really push any one thing too hard. We let people find the place and take what they want.

If you did the research out there and asked people. If they were to say 'it's a boat yard' isn't it and they didn't mention heritage, I wouldn't be devastated. The same would be if they said 'oh well it's a little museum' well okay.

Appendix G – AR Markers

According to the documentation (Etienne, 2018), markers can only be in black and white and cannot contain colours only light grey. The minimum resolution of a marker is 16px X 16px and they must be square in shape. The designs must be simple and afford good contrast. A simple shape, letter or symbol is recommended.

There are two different types of markers, 'pattern' and 'barcode'. Barcode markers contain a binary which stores a number. This could be useful in my project as there will be multiple locations with different assets equated to each marker. Pattern on the other-hand is just an image that can be recognised and therefore display the connected entity, there is no encoding involved.

Making my own marker

I created my own design and converted the image to a '.patt' file by using the following resource: <https://jeromeetienne.github.io/AR.js/three.js/example> Although the marker looks simple, the camera didn't seem to recognise it. Lighting is always a consideration (Hollerer & Feiner, 2004), but not in this case, the 'hiro' marker worked beforehand.

After a little research into the marker documentation I found that the background should be rgb(240,240,240). By viewing my .patt file in a code editor you can see that mine was incorrect (fig.2). It's also worth noting that there are 16 values per row so any design for a marker should be hitting that grid well for better recognition.



Fig.1 Marker designed in Adobe Photoshop.

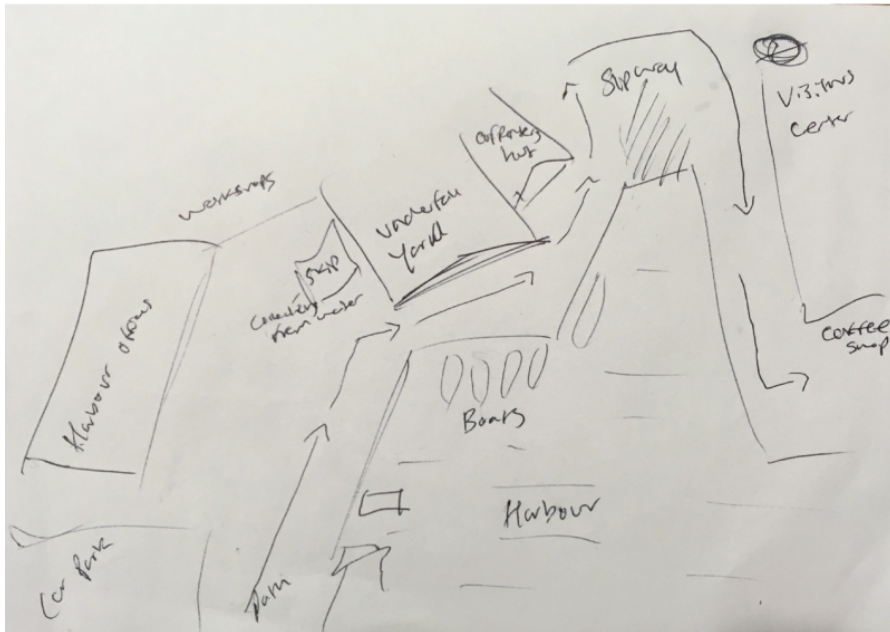
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1 255 255 255 255 255 255 255 255 255 255 255 255 255 255
2 255 255 255 255 255 255 255 255 255 255 255 255 255 255
3 255 255 255 255 255 255 255 255 255 255 255 255 255 255
4 255 255 255 255 255 255 255 255 255 255 255 255 255 255
5 255 255 255 255 255 195 75 75 75 120 246 255 255 255 255
6 255 255 255 255 255 171 0 0 0 0 64 251 255 255 255
7 255 255 255 255 255 171 0 0 0 0 31 244 255 255 255
8 255 255 255 255 255 171 0 0 0 0 58 251 255 255 255
9 255 255 255 255 255 171 7 89 14 49 236 255 255 255 255
10 255 255 255 255 255 171 21 255 170 8 186 255 255 255 255
11 255 255 255 255 255 171 21 255 255 85 40 249 255 255 255
12 255 255 255 255 255 203 110 255 255 187 117 248 255 255 255
13 255 255 255 255 255 255 255 255 255 255 255 255 255 255
14 255 255 255 255 255 255 255 255 255 255 255 255 255 255
```

Fig.2 .patt file binary code.

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- Etienne, J. (2018). *AR.js – Augmented Reality for the Web*. Available from: <https://github.com/jeromeetienne/AR.js/blob/master/README.md> [Accessed 02 December 2018].
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Appendix H – Field Sketches



Sketch.1 Field sketch of Underfall area of harbourside.



Sketch 2. Field sketch with the **inner-Underfall** highlighted in yellow. This area is where most people slow to look at what's going on. There are many POIs positioned here, but it's still a working place which should be taken into consideration.