

# Memory in Copper <sup>★</sup>

Doon MacDonald

Swansea University  
CHERISH Digital Economy Hub  
Swansea, UK  
[d.g.macdonald@swansea.ac.uk](mailto:d.g.macdonald@swansea.ac.uk)  
<http://www.cherish-de.co.uk>

**Abstract.** This paper discusses the design and implementation of a tangible user interface for accessing and exploring aural archives from the Hafod-Morfa Copperworks in Swansea. The work supports the work of Swansea University’s Digital Living History Lab, tasked to explore how digital innovation can support access to resource-constrained heritage sites.

**Keywords:** Audio · Heritage · Music · Objects · Archives.

## 1 Introduction

The Hafod-Morfa Copperworks in the Lower Swansea valley, Wales was once the busiest and largest Copperworks in Europe. Until recently, this 12.5-acre, post-industrial site was extremely polluted and now, despite a large regeneration project between Swansea City Council and the University, access to the public is limited and the site is still largely derelict. It is an unmanned heritage site that is positioned within a largely deprived area of Swansea with concerns of health and safety, vandalism and theft. Figure 1 shows a photograph of the Musgrave Engine <sup>1</sup> and represents the current state of the site.

Swansea university’s ‘**Digital Living History Lab**’ was set up to support the Copperworks and address connections between access, legacy and community. Specifically, the lab acts as an interface between creative thinking about digital interpretation of the site and the practical needs of visitors and the local communities. Research is carried out around strategies and digital innovations for sustaining public access to heritage sites.

### 1.1 A Copper Interface

This paper presents a physical prototype (‘Memory in Copper’) that was developed to support the work of the Digital Living History Lab. Specifically, documented is the design and evaluation of a playful and tangible interface to enable

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<https://thewillowworkshop.com>

<sup>1</sup> <https://www.flickr.com/photos/97373278@N07/sets/>

the public to listen to, connect and interpret aural archives, music and sounds from the Hafod-Morfa Copperworks. Importantly, the interface provides a means for the public to explore how combinations of sound, tangible object interaction and gesture can support their learning and engagement with the Copperworks without having to physically access the site itself.

From a public point of view, ‘Memory in Copper’ took the form of a piece of copper piping that they could freely pick up and move around (Figure 3 illustrates this). Moving the pipe triggered music, stories and sounds which were randomly played depending on how the pipe was moved. Previous works such as [1], [2] and [3] also used sound to explore the interpretation of heritage sites away from the museum setting. These works used geo-location techniques to trigger sounds and so required the public and hand-held mobile interface to be on the site they were experiencing and interpreting. ‘Memory in Copper’, however, focussed on providing a physical and aural-based experience of what it was like to work on the site, which did not require actual physical access to the site. The hand-held copper pipe could be used remotely and, arguably most importantly, provided the potential for an extra level of interpretation of the site from interaction with the copper itself.

## 2 The System Design

**Hardware:** The system was made from embedding electronics and sensors into the copper pipe. A Nintendo Wii remote was placed (and completely hidden) inside the pipe and secured to restrict any movement. It should be noted that a Wii remote was used but in theory any device with an accelerometer and gyroscope could be used and placed inside a tangible object that represents the site (a mobile phone, or Arduino board for instance).

The copper pipe was placed on a piece of black slate and rested on two pieces of wood so that the slate would not get damaged when the public lifted and placed the copper back. This also added to the overall presentation of the set-up which aimed to look as though it could be in a museum or similar context. The laptop running the software to control the hardware and play the audio was then placed inside a black metal box, which again was chosen to support the museum-type effect and ‘feel’ of the set-up. Figure 2 shows the set up.

**Software:** The laptop was used to run Max/Msp<sup>2</sup> and Touch OSC<sup>3</sup> to darwin remote OSC<sup>4</sup>. The signal between the laptop, Wii remote and headphones were sent via blue-tooth to avoid any wires and to enable the participant to feel less restricted when interacting with the copper pipe.

To create the interactive loop, every time the copper pipe was moved control messages were sent from the Wii remote via bluetooth to Darwin remote OSC.

<sup>2</sup> A graphical programming language [www.cycling74.com](http://www.cycling74.com)

<sup>3</sup> <https://hexler.net/software/touchosc>

<sup>4</sup> <http://www.matthiaskronlachner.com/?p=1574>

This software then sent open sound control messages (OSC) to the audio programming language, Max/MSP. Max/MSP, which was used to store and play the samples, was then used to trigger the samples before passing the audio from its outlets to the bluetooth headphones. The user then heard the audio and subsequently interacted with the copper to control the audio playback, hence forming an interactive loop.

## 2.1 The Sound Design

The system embedded a collection of 9 audio stories from ex-workers from the Copperworks. These were gathered at a workers lunch which took place in March 2018 and from the university archives from the CU@swansea project<sup>5</sup>. The stories were then divided up into sample lengths between 20 and 30 seconds.

The stories were all chosen for their potential to conjure up visceral and immersive imagery of what it was like to work at the factory. For the stories recorded during the workers lunch the ex-workers were asked specifically to comment on the sounds and smells of the site and the stories chosen from the archives all were explored for similar themes. There was also an effort to choose humorous passages from the stories. For example, there was a tale of a workers strike over the size of the sausages in the canteen. There was a story about how the clothing was so soaked with sweat at the end of the day that they made a “thwack” when they were thrown on the floor. There was also a story about a Lady named Becca-Pee who used to go around with a bucket on her head, gathering urine from the workers, in order to “pickle the copper plates”.

In addition to this, a rhythmic soundscape was composed by the author, made up of sounds of copper and industrial-style drums. A version of *Myfanwy*<sup>6</sup> was then arranged on a Trombone (a Brass instrument, which was used to reference the fact that brass is made from copper) and placed as a melody over the soundscape.

The aim of combining composed sounds, found sounds and aural stories was to explore the affect that combining different types of audio can have on audience experience and interpretation. Specifically, addressing potential round accessibility, enjoyment and aesthetics and how insights could be gathered and interesting connections made between the seemingly random (but carefully composed and arranged) combinations of audio.

## 3 The Installation

‘Memory in copper’ was set up in a Swansea University Marquee just outside of the Copperworks site. The occasion was to celebrate the visit of the Man Engine to Swansea. The Man Engine<sup>7</sup> is a giant mechanical puppet that celebrates the legacy of the UK’s mining industry. It is the largest puppet ever constructed

<sup>5</sup> <http://www.swansea.ac.uk/riah/research-projects/welsh-copper/>

<sup>6</sup> Welsh folk song, composed by Joseph Parry, published in 1875

<sup>7</sup> <https://goldentree.org.uk/portfolios/man-engine-2016/>

in Britain and stands at over 10 meters in height. The event was open to the general public and ran from 6pm-9.30pm on April 12th, 2018.

### 3.1 Public Engagement and Reaction

The Methods for collecting feedback on the installation included a comments book alongside a ‘tangible questionnaire’ which was made of 3 boxes: one with a smiley face, one with a neutral face and one with a sad face. Figure 3 shows the boxes and faces. Once the public had had a chance to play with the copper pipe and hear the audio, willing participants were asked to place a coin in one of the 3 boxes and invited to leave a comment.

Eighty Six people placed a coin in one of the boxes. 76 people (88%) of participants gave it a positive whilst 10 people (12%) gave it a neutral. No coins were placed in the ‘sad’ box. Alongside this we gathered 40 comments in total, some of which have been documented below to represent the varied scope of the feedback.

*“What a clever and innovative idea! Loved how when you moved it, it was like different radio stations tuning in, very clever”*

*“A bit confusing”*

*“At first it didn’t make any sense but it gradually got a bit more understandable”*

*“Brilliant - I would love to have time to listen to all the reminiscences”*

*“ddim yn rhy ddrwg”<sup>8</sup>*

Generally, the comments were largely positive. These included three comments which focussed on issues of the context for the installation and the need to have more time to play with it. Two of the participants commented on their level of understanding, which could be interpreted as an issue with knowing how best to interact with the copper pipe or with an understanding of the sound itself. Three of the comments were specifically focussed on the novelty of the set up and concept.

The participant behaviour was worthy of note and what follows are generalisations from initial observations and, given a larger study, could be interesting lines of enquiry to pursue. Frequently participants, although initially tentative smiled at the humour of the stories and seemed to enjoy the experience. In general the younger the participant the longer they spent listening to the complete stories whereas adults generally were curious to explore how the system worked and assess its scope and limitations.

In summary, there was a mixed audience engaging with the set up. It appealed to a cross-generational demographic (including people that used to work on the

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<sup>8</sup> Translation from Welsh to English = ‘Not Too Bad’

site itself) and provided a talking point and trigger for further conversations about working and experiencing life at the Copperworks, as well as in and around the Hafod-Morfa community.

**Limitations:** The installation highlighted potential for improvement in the set up. Specifically, ideas for improved study design in order to inform the audio content. It would have been prudent, for example, for the researcher to also have a pair of headphones in order to monitor where the participant was once they were listening to the sounds. It was apparent that a lot of participants demonstrated their reaction to the sounds through expressive facial reactions. Therefore, it would have been useful to make interpretations between these expressions and the sound that they were listening to in order to inform further ideas for sound design. It also would have been useful to measure how long participants spent with each sound before shaking the copper pipe to switch to the next sound. For example, it would have been possible to capture interaction logs (within Max/MSP) which could have contained details on timings and patterns of movement.

## 4 Future Potential and Research Areas

‘Memory in Copper’ is a prototype that was designed to explore how tangible, embedded, audio interactions can support the interpretation and experience of resource-constrained, unmanned heritage sites with limited access. The use of ‘audio objects’ as a way to inspire comments and narratives around heritage. It is argued here that there is huge potential around this area of research. Specifically, that the combination of audio and object interaction can be used to support engaging and fun public experiences for a wide demographic.

This proof-of-concept offers potential to other resource-constrained sites in that the site-specific object or artefact that the public interact with can change and the audio can be replaced with specific archival footage and bespoke compositions but the principle can remain the same.

## References

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**Fig. 1.** The Musgrave Engine. An insight into the derelict site.



**Fig. 2.** A picture of the set up: copper pipe, bluetooth headphones and metal box used to house the laptop.



**Fig. 3.** Gathering Feedback from the Public. Participants placed a coin in one of the boxes to give feedback on their experience.