Palimpsests of Time and Place

J Fishenden and A Hugill
Institute of Creative Technologies
De Montfort University
Leicester, UK

***Abstract* — This paper discusses ongoing research into the development of an original composition portfolio themed on the concept of palimpsests of time and place. The research involves the application of an iterative development methodology to refine creative computer-based techniques for the exploration and navigation of multi-dimensional aural and visual content operating within three-dimensional Cartesian space. Various computational functions for utilising a web browser-based system, oriented around a conceptual n-tier layer model, are being developed and refined. Visualisation computational processes related to images (still and moving) of the same place (such as a building) or other artefact (such as a map) over time utilise both authentic and synthetic content. Auralisation computational processes include authentic and synthetic impulse responses (the acquisition of the acoustic characteristics of particular spatial environments) and convolution reverb (recreating the acoustic reverberation characteristics of a physical or synthetic space based on an associated impulse response). The research is applying an iterative theory-composition-testing cycle to optimise intuitive computer-based processes for enabling users to navigate multiple layers of content, as well as in finding methods that evoke an increased emotional awareness of, and connection with, the past of place over time. Consequently an integral component of the research methodology involves the emergent computational techniques being subjected to formalised usability testing both to assist with their further refinement and to assess their value in evoking an increased awareness of time and place.**

Keywords: creative computing; creative technologies; palimpsests; composition; rich internet applications; usability testing

I. INTRODUCTION

The research is developing an original composition portfolio utilising creative technologies themed on the concept of palimpsests of time. The term "composition" is being used in the same context as Mark Canter envisaged it, namely as combining:

> *"... all forms of media, orchestrating fragments of graphics, animation, and text, in juxtaposition with sound and musical passages, into a single artwork."* [1]

The concept of the palimpsest (hidden layers of the past that lie below the visual and aural surfaces of our contemporary landscapes and soundscapes, and which influence our perception and understanding of place) plays a key thematic role in this research. It is being explored and refined as a compositional element in the evocation of the past of place or person. Various creative computing techniques originated in this research explore different ways of manifesting these hidden layers, with the aim of identifying those which prove most effective at creating an artistic evocation of the past. Whilst this research is about place it is not site-specific. The role of place is a thematic element of the composition portfolio, which is in part about the evocation of the experience of place in the context of internet-delivered and experienced works, and those exhibited and experienced in performance spaces.

The primary hypothesis is that creative technologies compositions can evoke an awareness of, and an emotional connection with, the past of a place or person in an audience, independent of their current location. To test this hypothesis, the production of the portfolio of original creative technology compositions and the realisation of their artistic intent is being informed by user feedback. Usability testing aims to evaluate the artistic effectiveness or impact on an audience of the research's original techniques and partial/final compositions by gathering feedback both online over the internet and in usability labs.

The composition portfolio and research feedback mechanisms explore the artistic application of the concepts that Barthes considers in "Camera Lucida" [2]. Barthes distinguishes between the mix of general symbolism inherent in a photo (that which anyone would see, which he termed the *studium*) and that which was profoundly personal and intimate (which he termed the *punctum*). This research shares his objective of seeking to find an effective means of conveying the sensation encapsulated in the punctum to others: how might it be possible to convey something that so "pierced the viewer" to another who has no direct link to the subject or place portrayed?

Computer-based creative techniques have a well-respected heritage as integral compositional elements in digital artworks [3]. Alongside the digitisation of traditional creative works, such as photographs, and their utilisation in computer-based systems, original artistic practice has produced new forms of computer-based art [4], including art developed for and based exclusively on the internet [5].

A key element of the research involves the research and development of creative computing techniques for retrieving and displaying visual and aural content relating to the present and past of place, including images (still and moving) of locations in both urban and rural locations. Contemporary computer systems provide a variety of means of displaying such visual content, including side-by-side "then" and "now" images that show how a place has changed over time. This might include for example

images of a famous building, or maps of a city. However, this approach to the visualisation of information differs little from static printed publications that have long utilised side by side "then" and "now" images to demonstrate how a place has changed over time. What is sought is an improved method of visualising the changes to place over time that allows users interactively to navigate and explore "then" and "now" in a more effective, visually and aurally evocative way through the use of digital creative technologies. The concept of the palimpsest that underpins this research has provided the basis for other creative works based on new technologies. "*The Palimpsest System*" for example applies the concept of the palimpsest to "*combine one photograph with another on a pixel-by-pixel basis and to apply Cellular Automata rules to further mix in real-time the images together*" [6].

This paper discusses several computer-based techniques being developed as part of the creative technologies composition portfolio, detailing how those techniques are being informed by an iterative methodology that utilises structured feedback obtained both online and in usability labs.

II. N-TIER NAVIGATION

The research currently in progress includes an exploration of various methods and techniques for utilising a web browser-based system to enable a user to discover and navigate multi-dimensional layers of visual and aural content. The primary conceptual model envisages *n*-tiers of visual and aural content beneath surface level content, illustrated in Fig.1, operating across the Cartesian co-ordinates for a three-dimensional space. Such content is typically related to visual images (still and moving) of the same place (such as a building) or other artefact (such as a map) over time and either authentic or synthetic sound. The research interest is both in finding an intuitive way for users to navigate such multiple layers of content, as well as in finding methods that evoke stronger emotional connections with the past of place.

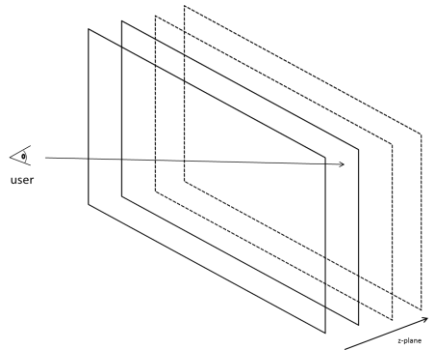

Figure 1. The n-tier layer conceptual model

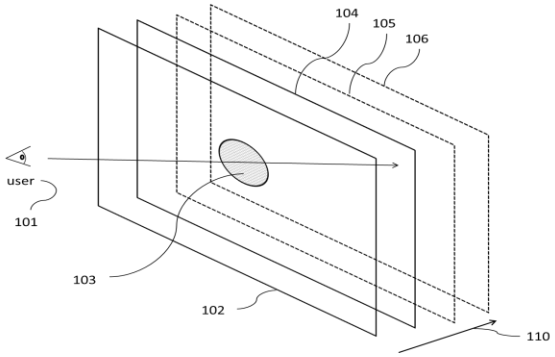

Figure 2. *n*-tiered visual content (lens model)

III. INITIAL VISUAL NAVIGATION CONTROLS

A. Lens

Fig.2 illustrates an example implementation of the conceptual model, where underlying *n*-layers (104-106) of visual content contained in the z-plane (or axis, 110) can be revealed through the use of a circular aperture (or lens, 103) which the user (101) can freely position on the x and y axes through movements of a mouse. Wherever the lens moves in reaction to user mouse movements, it reveals the underlying visual content existent below a surface layer (102).

The prototype technique is directed towards reacting to specific user action initiated by movement of a mouse (or potentially another input control device, such as use of a finger on a touch screen) to navigate a circular aperture (lens) across visual content. The result is that the visualisation area over which the lens moves reveals underlying related visual content (layered in the z-axis). As the lens is moved by the user across the x and y axes of the surface layer, underlying *n* layers located in the z-plane are visualised in the area of the lens, revealing visual content related to those particular co-ordinates.

Underlying visualisation control code tracks where the lens object is situated on-screen relative to the surface manifestation through visualisation display logic, which tracks the movements of the mouse and updates the corresponding x and y axes co-ordinates of the on-screen lens control. There typically are limits on these calculations so that the lens control does not wrap from one edge of the screen to the other, although such wrapping is feasible.

The initial realisation of the application of this technique was coded in Microsoft Silverlight 1.0, utilising the eXtensible Application Markup Language (XAML) for design elements and Javascript for code-behind. Silverlight's representation of Cartesian co-ordinates for a three-dimensional space is shown in Fig.3.

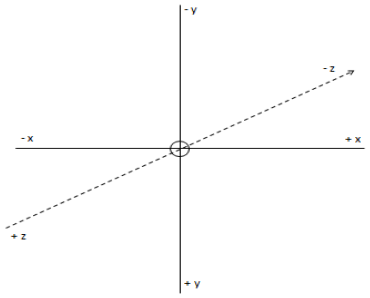

Figure 3. Silverlight's 3-dimensional co-ordinates

Figure 4. Palimpsest navigator lens (lens without user focus)

Figure 5. Palimpsest navigator lens (lens with user focus)

An example visualisation prototype is illustrated in Fig.4. When the user positions the cursor over the lens the underlying image becomes less opaque (Fig.5) and an associated sound is invoked to provide aural reinforcement that the lens has entered an interactive state. When the mouse button is clicked and held down, the user is able to begin moving the lens around the screen, revealing an additional visual layer of the same place at an earlier time. The user can choose to stop moving the lens around the screen by releasing the mouse button. The cursor then disengages from the lens and can be moved away, restoring the lens to its passive state.

B. Slider

A second technique for navigating visual layers of place over time was developed utilising an on-screen slider control. This was programmed in the same environment as the lens, Silverlight 1.0. An example prototype is illustrated in Fig.6. Movement of the slider progressively reveals an additional layer of the same place at an earlier time.

Figure 6. Palimpsest slider control

Figure 7. Palimpsest slider control (images mixed)

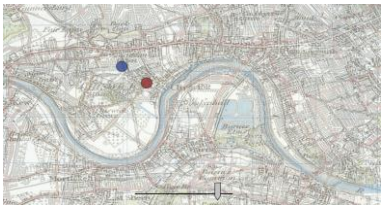

Figure 8. Palimpsest slider control (maps - images mixed)

Unlike the lens control, the slider control affects the entire visual image displayed, also allowing fine-grained merging of the images so that the user can adjust the extent to which one or other images dominate the mix, or whether both are mixed equally (Fig.7). In other applications of this technique more than two layers are manipulated, a model that has been applied to maps of the same area over time (Fig.8).

IV. Initial Aural Navigation Controls

The *n*-tiered model outlined in the previous section is also being applied to aural content. Research in this area has included developing the role of impulse responses (the acquisition of the acoustic characteristics of particular spatial environments) and convolution reverb (recreating the acoustic reverberation characteristics of a physical or synthetic space based on an associated impulse response). Aural-related tests in the usability lab and online are providing feedback on the impact of different impulse responses upon user perception and evocation.

In terms of evocations of the past of place, the creative interest is in how sound behaves in different buildings and structures – architectural and vibration acoustics. In particular, how impulse responses may differ over time. For example, between period rooms spanning the late 1600's to the late 1990s. The research has involved the capturing of such impulse

responses in a range of period environments at London's Geffrye Museum in order to enable their subsequent application within compositions, and testing of their impact on an audience. Aural content for the portfolio is being influenced by several elements: authentic impulse responses of available original locations; synthetic (or imaginary) impulse responses; and the subsequent use of both in convolution reverb tools.

The application of the *n*-tier model at an aural level is thus primarily twofold: the use of impulse responses at progressive *n* levels (for example, layer *n*+1 being 20th century, *n*+2 19th century and so on); and of the embedding of sounds (both authentic and synthetic) within a surface visual layer and, optionally, other layers below. Fig.9 illustrates multiple aural elements embedded across *n* layers. In such a case, the embedded audio content could utilise impulse responses gathered from historic sources. For example, each *n* tier could relate to a particular time period and each audio element embedded within that tier could utilise an impulse response/convolution reverb appropriate to that tier. Thus the further back into the tiers the user navigates and listens, the earlier the related impulse response.

In one technique under evaluation, multiple aural elements are embedded without any visual indication of their existence within a single surface layer, with all elements being continually audible, generating an overall background soundscape comprising multiple layered sources. When a user moves the cursor across one of these hidden aural elements, the cursor is modified to show a hand (a visual cue to reinforce that an aural element exists at that on-screen location) and the related aural element has its volume boosted to become more prominent than the others contained in the aural layer. When the user moves the cursor away from that aural element, the volume is reduced and the element returns to the general background mix. Fig.10 illustrates one of the examples being used for prototyping and usability feedback.

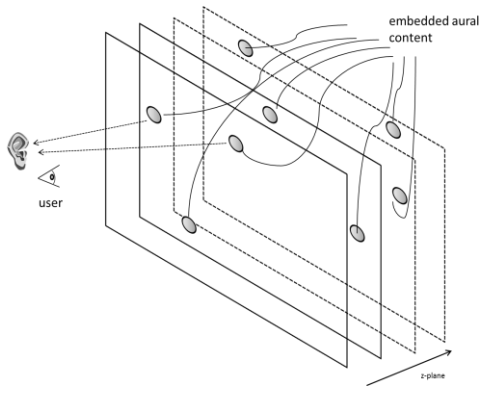

Figure 9. Aural content embedded within *n*-tier layers

Figure 10. Embedded, hidden, aural elements

V. USABILITY TESTING

This research formalises the gathering and analysis of user responses during the content interaction stage of the overall realisation methodology being employed (see Fig.11). This feedback informs subsequent, iterative developments in the content origination, content pre-processing and content mapping stages.

As Mueller *et al* observe [7], usability testing brings many benefits to the development of user-related application development. Jeffries *et al* [8] have demonstrated that two methods of testing (usability testing and heuristic evaluations) provide the most effective outcomes:

> *"... results show that guidelines and cognitive walkthroughs can be used by software engineers to identify some important usability problems when UI specialists are not available. However, heuristic evaluation and usability testing have advantages over those techniques. Many of the most severe problems found in the study simply could not be identified by guidelines or cognitive walkthroughs."*

Usability testing has been adopted as the evaluation method for this research: usability lab studies enable systematic observation (under controlled conditions in the IOCT usability lab) of users to assess how well they interact with and respond to compositional techniques (including alternative approaches to interacting with layers of images and sounds).

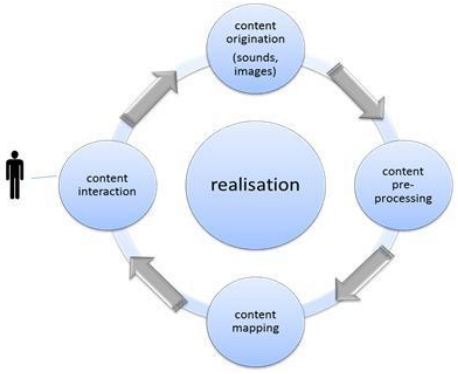

Figure 11. User feedback, part of content interaction of the composition realisation methodology

These are complemented by online feedback mechanisms for internet users interacting with compositional elements and techniques over the web. Whilst online techniques lack the systematic observation under controlled conditions achievable in the usability lab, they have provided insight into the effectiveness of the techniques and examples for a random, self-selecting sample of remote users encountering them on the internet. The usability lab however provides a more detailed data-gathering and analysis process that can help better determine *why* certain responses are being made.

Four areas are being assessed in the usability lab stages of this research:

- **performance:** the time taken to, and ease with which users, complete relevant tasks (such as interacting with palimpsestic content using the various interactive tools)
- **accuracy:** whether users interact in the expected way or deviate (that is, behave in ways the composer did not intend or anticipate), indicating that the composition's presentation, design and associated techniques may not be optimal for the composer's intended purpose
- **recall:** how well the user is able to recall content or elements of the composition afterwards, and to identify those elements, ideas (visual and/or aural) or techniques that were most, or least, significant for them
- **emotional response:** how the user feels about the compositions, whether they feel they have evoked a sense of the past of place or person

According to Nielson, "*...usability testing with five people can uncover 80 percent of ... problems.*" [9]. In earlier research with Landauer [10], Nielson determined that:

> *" ...the number of usability problems found in a usability test with n users is N(1-(1-L)n) where N is the total number of usability problems in the design and L is the proportion of usability problems discovered while testing a single user. The typical value of L is 31%, averaged across a large number of projects we studied."*

Plotting the curve for L=31% gives the result shown in Fig.12.

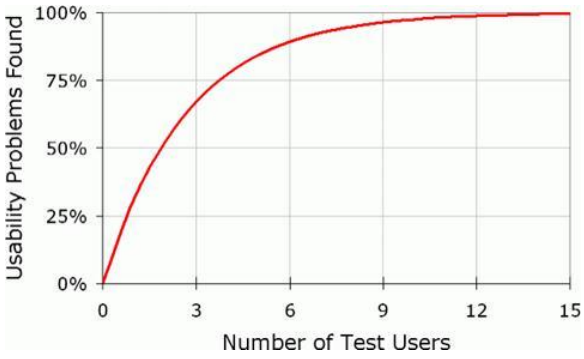

Figure 12. From J. Nielsen and T.K. Landauer: "A mathematical model of the finding of usability problems"

Nielson proposes an iterative approach, stating that a set of three iterated tests with five users apiece will achieve more than a single test with fifteen users. However, the claim that five users is sufficient proof in usability testing has been challenged, for example by Spool and Schroeder [11]. They do not identify a specific alternative number. Instead, their paper confirms that the overall "*formula can be usefully applied*", but that a different value of L needs to be found. More specifically, Faulkner [12] found that:

> *"It is widely assumed that 5 participants suffice for usability testing. In this study, 60 users were tested and random sets of 5 or more were sampled from the whole, to demonstrate the risks of using only 5 participants and the benefits of using more. Some of the randomly selected sets of 5 participants found 99% of the problems; other sets found only 55%. With 10 users, the lowest percentage of problems revealed by any one set was increased to 80%, and with 20 users, to 95%."*

A target of between 8 and 12 participants was established for formalised usability lab testing as part of this research, based on precedent and literature reviews (which suggest that a minimum of 80% of "problems" users might experience with the compositions would be identified by such a sample size). A larger number was desired for online feedback, given the increased ambiguity of online testing (for example, the lack of insight into the environments in which users were interacting with compositional techniques and the experience on which their feedback assessments were based).

VI. Usability Findings and Impacts

A. *Online – part 1*

An initial online user feedback survey ran from April 2009 to August 2009 on the researcher's web site in order to evaluate the initial techniques developed during the course of this research. During this period, a total of 30 completed responses to the user feedback survey were received.

Overall conclusions drawn from an analysis of the online survey feedback into the next iteration of compositions and associated evaluation mechanisms included the following:

- a high level of consensus that the compositions were easy to use [93.3% of respondents]
- the compositions were evocative of the past [96.6% of respondents]
- greater user control/interactivity was desired [38% of respondents]
- the magnifier/lens was the more effective technique [56% of respondents]
- the slider was the more effective technique [12.5% of respondents]

These conclusions provided useful inputs to the next stage of iterative development of the research. Of particular relevance to the underlying hypothesis was the finding that the majority of respondents indicated that they found the sample compositions

evocative of the past, and that the prototype techniques were effective.

B. Online – Part 2

The second stage of online feedback ran from March 2010 to August 2010. Feedback received during this period, utilising star ratings (where one is least effective and five most effective), is set out in Table 1 (in the order in which the techniques were displayed on the research page). These testing and usability feedback techniques, in combination with free-form feedback, have provided a useful model that mitigates some of the difficulties of web-based testing noted by Di Lucca [13]. Note that this table includes other techniques being developed for the composition portfolio that are outside the scope of this paper.

TABLE 1: TECHNIQUES, 2ND STAGE ONLINE FEEDBACK

Technique	Overall star rating
Senseport lens (overall)	4.4 (106 votes)
Senseport lens – Cleopatra's needle	4.1 (76 votes)
Senseport lens - Cenotaph	4.3 (91 votes)
Senseport lens – London maps	4.6 (94 votes)
Senseport lens – West London streets	4.2 (79 votes)
Senseport lens – Chiswick Empire	4.1 (73 votes)
Senseport lens (magnifier) – Chiswick Empire	3.2 (71 votes)
Mouse-controlled slider (overall)	4.0 (75 votes)
Mouse-controlled slider – old Fleet river (moving)	3.4 (71 votes)
Mouse-controlled slider – old Fleet river (still)	3.4 (70 votes)
Mouse-controlled slider – West London streets	4.4 (77 votes)
Mouse-controlled slider – Trafalgar Square (moving)	4.5 (79 votes)
Mouse-controlled slider – West London hybrid	4.2 (76 votes)
Other techniques (overall)	3.8 (71 votes)
Other techniques – Tyburn tree	3.9 (88 votes)
Other techniques – Mansion House (hidden sounds)	4.0 (74 votes)
Other techniques – streets deepzoom	2.7 (73 votes)
Other techniques – 3d homes	3.3 (76 votes)
Landing Pages (overall)	4.0 (54 votes)
Landing Pages - linear	3.1 (75 votes)
Landing Pages - cyclic	4.3 (83 votes)
Landing Pages - rotational	4.1 (90 votes)

C. Usability Labs – Part 1

The first usability lab sessions were conducted over two days in May 2010. A variety of inter-related feedback collection methods were utilised for the usability lab sessions:

- **Observation**: an observer (researcher) observed the participant through one-way glass (and via video and audio links) during their interaction with the compositions, also taking contemporaneous notes
- **Formal feedback**: on completing the session, the participants each completed an online feedback questionnaire
- **Informal feedback**: on completing the session, the observer de-briefed the participant and gathered their informal impressions of the usability session
- **User oralisation**: during the participant's interaction with the compositions, they were encouraged to speak aloud, oralising their feelings, emotions and responses (describing orally whatever they are looking at, thinking, doing, feeling)
- **Automated instrument data collection**: throughout the session, video and audio recordings were captured, with one video/audio stream focused on the PC screen and the participant's interactions with the compositional techniques, and the other focused on the participant and their responses, gestures and other actions

The usability lab sessions with the 9 volunteers resulted in 11 hours of video/audio for later transcription and analysis, as well as the contemporaneous notes and formal end of lab session feedback form.

With regard to the usability areas being assessed during the lab stage (performance, accuracy, recall and emotional response), the following are some of the key elements identified from user feedback:

- performance:
  - some participants did not utilise the lens. Clearer cues are needed on how the lens is to be used, or an alternative approach (such as the mouse cursor *being* the lens by default) need to be considered to enable its more effective, ubiquitous use
  - some participants indicated difficulties noticing and using the mouse-controlled slider. More consistent positioning and highlighting of the slider is required, or the mouse itself needs to act as the slider and modify the content based on its positioning and movement
  - some participants did not explore the hidden sounds example, indicating a preference for more visually-driven works. Others indicated that better visual cues were needed to guide them to find the sounds and that full screen mode by default would make the piece easier to use.
- emotional response:
  - numerous participant responses indicate that the pieces evoked a sense of the past of place or person including:
    - *"These [provided] … poignant connections between past and present because the link between the two was highly explicit"*
    - *"Makes me wonder what it would have been like to have lived in that time."*
    - *"Some wreathes lying around the bottom of the cenotaph, it's rather beautiful"*
    - *"Oh, bring back the green fields!"*
    - *"What you get in effect is a vision of a rural, less populated time."*
    - *"It's intense, it's mind-blowing for me."*
    - *"You can control how much of the past and how much of the present you are looking at. I think this is really effective."*
    - *"Even the texture/tone of those images makes you feel nostalgic."*
    - *"[That's] so powerful."*

- *"I like [the] fusion of time and space."*
- *"This is the most engaging image that I've looked at. The sense of time ... It really is, it works well. It's about what's going on, not just the architecture."*
- *"[Makes me think about] the whole notion of place, and how areas are given significance."*
- *"Wonderful landscape of sounds and of images."*
- *"Poetical and full of potential. So physical and metaphysical."*

Such feedback is useful on at least two levels. It helps establish whether the primary hypothesis (that creative technologies can evoke an awareness of, and an emotional connection with, the past of a place or person in an audience, independent of their current location) can be evidenced by user responses. And it provides insightful feedback into how the techniques can be further refined, thereby strengthening their evocative impact.

VII. Second Generation Palimpsest Navigation

The online and usability lab feedback indicated several areas where the creative techniques were failing to provide the desired user experience. This feedback was therefore analysed in order to identify methods of improving the techniques in use. During this time the target computer development environment migrated to Silverlight 3.0 (and subsequently Silverlight 4.0), utilising managed code and the use of C# in place of Javascript.

A. Visual Navigation Controls

1) Lens

The subsequent iteration of development took into account the usability feedback, notably the idea that the cursor should become the lens rather than the user needing to select the control. The revised code therefore ensured that the lens exists in place of the cursor: or, more accurately, the lens becomes the cursor, such that user movements of the mouse (or another input control device), moves the lens around the surface visual content, revealing through the lens related visual content underlying the surface image (which may be still or moving). This also has the potential benefit of enabling the mouse button down event to be used for other purposes, such as enabling further tiers to be revealed and navigated (Fig.13).

Figure 13. The cursor as lens (revised control)

Figure 14. The lens resized (revised control)

Figure 15. The cursor as slider (revised control)

Also in response to usability feedback, the lens was recoded to provide a means of scaling its size, allowing it to be resized to a large radius, or shrunk to one much smaller (Fig.14). This was achieved primarily through use of a mouse scroll wheel (although the technique would equally support alternative input control devices, such as a suitable movement of fingers on a touch screen). Adjustments made via this input mechanism enable the size of the lens aperture to be increased or decreased, revealing more or less of the underlying visual content.

2) Slider

Revisions to the underlying design and computational code for the slider also took into account the usability feedback, notably the desire for the cursor to become the slider. The effect of this change is that no on-screen controller is required and instead left and right mouse movements control the blending of the visual layers (Fig.15). As well as de-cluttering the user interface, this revised technique is intended to address the issues identified in the usability testing whereby users did not understand how to use the slider to manipulate the layers of place. As with changes to the lens navigation technique, this modified approach also frees up the mouse button down event for potential re-use in navigating additional tiers of content.

3) Additional Techniques

An additional technique was also introduced for evaluation following the usability feedback. This uses a variation of the mouse as slider technique, but instead of merging or manipulating two or more entire images of the same place over time, the underlying images are partial. The result is that when fully blended, the view remains largely of the surface visual content, but modified by select images from the z layer(s) below. This is illustrated in Fig.16.

Figure 16. Visualisation with partial z-plane imaging

Figure 17. Custom cursor design

B. Aural Navigation Controls

Usability feedback identified two key areas in relation to users' interaction with aural content: the size of the visual image host (which needed manually to be taken full screen, since the smaller the image the harder to navigate and locate embedded aural content); and the lack of adequate visual cues regarding how and where to locate the embedded aural content.

The issue of the screen size was addressed through recoding in Silverlight 4 and ensuring that the initial screen occupied 100% of the available browser display screen via automatic detection of the available screen estate on program loading. It should be noted that Silverlight does not by default allow any application to start in full-screen mode: that action can only be user initiated.

The second issue, of inadequate on-screen cues for locating visual element, was addressed by making several design changes. The first of these was to develop a custom cursor to be used in place of the default. In this case a cursor styled on an old gramophone player horn was designed and coded, as illustrated in Fig.17.

The second design change was the development of an animation that would distort the custom cursor whenever it entered an area of embedded aural content. This is illustrated in Fig.18, although note that the screen capture cannot represent the animated nature of the cursor, which continues to swirl and rotate for as long as the cursor remains in the embedded aural area. As with the previous iteration, this example also boosted the volume of the aural element over which the cursor was positioned.

Figure 18. Custom cursor animation (event triggered by embedded aural content)

VIII. CURRENT AND FUTURE WORK

The research is continuing to originate, develop, refine and integrate various computer-based techniques and methods for the representation and navigation of both visual and aural content alongside the integral utilisation of usability testing.

Kera [14] discusses the phenomenom of real time visualisation drawn from various datasets and databases as a means of conceptualising our contemporary cosmopolitical condition. Extrapolation of the concept of palimpsests of place and time in this research is being iteratively extended into the use of contemporary social media sites integrated with older archives and sources. Social media, such as Twitter, and other online sites provide open APIs that enable the access and consumption of their data and services within third party applications. This research is currently prototyping the use of open APIs from three primary online sources: Twitter, flickr and Freesound (a repository of online audio field recordings). Aligned to this research's interest in the past and present of London, the primary filters being used across these resources are those related to London content, as well as those of related historic relevance (for example, accessing flickr images tagged as relevant to architectural palimpsests or old advertising).

The research is originating a variety of still and moving images and field audio recordings as resources for this research, and has also been granted permission from Getty Images to re-use archive moving images of London, and from English Heritage London Region and the City of London, London Metropolitan Archives for the use of old still images of London. To increase the available sounds and images accessible to this research, and to layer present and past in more complex models, the open APIs from Twitter, flickr and Freesound are being consumed as resources within the underlying programmatic model. These enable layers of recent and older content, both aural and visual, to be utilised alongside other resources.

Two specific techniques are currently being evaluated: (a) a 3D rotational cube layered cube, onto the faces of which are dynamically rendered images returned by the flickr API (Fig.19); (b) a particle emission and movement algorithm, used to render "tweetboxes" containing contents returned by Twitter (in this case, the Tweeter's logo image and the contents of their most recent tweet).

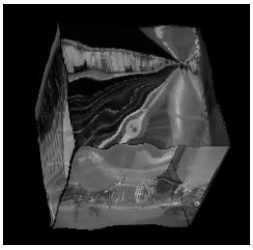

Figure 19. Rotating 3D cube

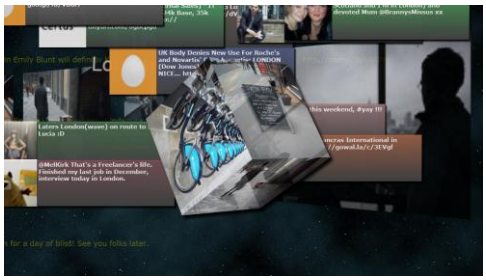

Figure 20. LondonLive - work in progress

Background elements comprise a scrolling list onto which other breaking tweets can be mapped, and a set of additional flickr images using plane projection within the z-axis to create the impression of reaching deep inside the screen space. Freesound returns randomly selected audio related to London locations. A control panel provides user control over these elements which can be individually toggled on/off. A series of custom timers regularly updates the content retrieved via the APIs. A current prototype of this work, LondonLive, is shown in Fig.20.

Further iterations and refinements are currently in progress, including the incorporation of texts and quotes relating to London from across the centuries and the insertion of historic images (still and moving) together with the addition of audio created and sourced by the researcher. The final composition will fuse current and past London in a visually and aurally immersive, layered and interactive space. Further visual refinement using other creative computing techniques, such as the application of custom pixel shaders, is also being explored.

There will be continued use of the internet as a feedback and improvement mechanism for the techniques and compositions in development. Further usability labs are also envisaged during the remainder of this research with the lessons learned from these additional feedback sessions iteratively incorporated into the original composition portfolio. Usability-informed techniques and methods of the type discussed in this paper provide an essential element of the final composition portfolio (combining both audio-visual and aural-only works), thus enabling it to become more evocative and emotionally connective with an audience.

IX. CONCLUSION

This research remains ongoing. Significant progress has already been made to date in utilising the iterative methodology to develop and refine new creative computing techniques that enhance the navigation and evocation of multi-dimensional representations of place over time. Whilst instantiated in a specific development environment (Silverlight), the underlying design and realisation principles are more broadly adaptable in other computational environments, including the emergent HTML5.

It was Richard Wagner who originally proposed the concept of Gesamtkunstwerk (total artwork), a theoretical model for a fusion of the arts and:

> *"... the unification of music, song, dance, poetry, visual arts, and stagecraft. His drive to embrace the full range of human experience, and to reflect it in his operas, led him to give equal attention to every aspect of the final production. He was convinced that only through this integration could he attain the expressive powers he desired"* [15]

This research has developed and integrated creative computing techniques as an integral part of the realisation of a composition portfolio that incorporates both visual and aural elements (incorporating user interactivity) to provide an emotional, connective "expressive power" related to our understanding of time and place.

Refined techniques for incorporation into the final composition portfolio are being subjected to related usability testing, both online and in the usability lab. This research has identified a clear value for usability testing in the development of original creative works: the findings and feedback to date have been integral to proving the hypothesis of this research and in ensuring that the evocation of the past of place is achieving a greater user impact than might otherwise have been the case.

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