Manchester Metropolitan University

e-space

Manchester Metropolitan University's Research Repository

Please cite the Published Version

Hook, Jonathan, Briggs, Jo, Blythe, Mark, Walsh, Nathan and Olivier, Patrick (2013) Repentir: digital exploration beneath the surface of an oil painting. In: CHI '13: CHI Conference on Human Factors in Computing Systems, 27 April 2013 - 02 May 2013, Paris, France.

DOI: https://doi.org/10.1145/2468356.2479581

Publisher: Association for Computing Machinery (ACM)

Version: Accepted Version

Downloaded from: https://e-space.mmu.ac.uk/632196/

Additional Information: © Owner/Author 2013. This is the author's version of the work. It is posted here for your personal use. Not for redistribution. The definitive Version of Record was published in CHI EA '13: CHI '13 Extended Abstracts on Human Factors in Computing Systems, http://dx.doi.org/10.1145/2468356.2479581.

Enquiries:
If you have questions about this document, contact openresearch@mmu.ac.uk. Please include the URL of the record in e-space. If you believe that your, or a third party's rights have been compromised through this document please see our Take Down policy (available from https://www.mmu.ac.uk/library/using-the-library/policies-and-guidelines)

Repentir: Digital Exploration Beneath the Surface of an Oil Painting

Jonathan Hook
Culture Lab
School of Computing Science
Newcastle University, UK
jonathan.hook@ncl.ac.uk

Jo Briggs
School of Design
Northumbria University
Newcastle upon Tyne, UK
jo.briggs@northumbria.ac.uk

Mark Blythe
School of Design
Northumbria University
Newcastle upon Tyne, UK
mark.blythe@northumbria.ac.uk

Nathan Walsh
Bernarducci Meisel Gallery
37 West 57th Street
New York, USA
bernarducci@meiselgallery.com

Patrick Olivier
Culture Lab
School of Computing Science
Newcastle University, UK
patrick.olivier@ncl.ac.uk

Abstract
Repentir is a mobile application that employs marker-less tracking and augmented reality to enable gallery visitors to explore the under drawing and successive stages of pigment beneath an oil painting's surface. Repentir recognises the position and orientation of a specific painting within a photograph and precisely overlays images that were captured during that painting's creation. The viewer may then browse through the work's multiple states and closely examine its painted surface in one of two ways: sliding or rubbing. Our current prototype recognises realist painter Nathan Walsh's most recent work, "Transamerica". Repentir enables the viewer to explore intermediary stages in the painting's development and see what is usually lost within the materially additive painting process. The prototype offers an innovative approach to digital reproduction and provides users with unique insights into the painter's working method.

Author Keywords
Digital art; marker-less tracking; SIFT; visualization.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.



Figure 1. Preliminary drawing and two later mid-production states of Transamerica.

©Nathan Walsh.

Background and Motivation

Repentir or Pentimenti are changes that are made to a painting as an artist corrects mistakes or alters the composition of the final work. Such changes have long fascinated art historians and have been identified in old masters using technologies such as X-Rays. Repentir is a mobile application that allows gallery visitors to explore the hidden layers behind the surface of *Transamerica*, the latest work by Nathan Walsh. Walsh is a fine art painter in the hyperrealist school who sells his work in an international market brokered by a major gallery.

During a series of semi-structured interviews conducted with Walsh, he described the prolonged process (up to four months) employed in making his paintings [2]. His creative process involves multiple stages and techniques, which each have their own interesting effects and artifacts (Figure 1). An initial line drawing takes several weeks to achieve, and then successive layers of oil paint are built up until the final image is complete. The nature of the process is such that many intermediary but beautiful images are effectively covered up as the final piece is created [1].

Walsh was not interested in standard "giclee" reproductions of his work, which he regarded simply as "poorer versions" of the original. He was not however opposed to the idea of multiples or editions in principle. Rather he felt that prints should "stand on their own terms as pieces of work" [ibid]. Therefore, he was curious and enthusiastic about exploring forms of digital reproduction in the context of a programme of research investigating the notion of a "digital original" [5]. With this in mind Walsh agreed to make daily photographs of the next canvas he worked on in order to create a series of images documenting the development of a painting over time.

Revealing the Hidden Layers

Walsh has recorded Transamerica's development since starting the painting at the beginning of September 2012. He uses a tripod mounted with a high quality stills camera and 35mm lens to capture an image of the painting at the end of each working day.

Discussions with Walsh led to the proposal of a number of different ways that the sequence of images, or layers, of the painting could be presented. The progress of the painting could be shown "as live" in an art gallery or in a public space such as a metro station. Alternatively, the completed "edition" of reproductions could be collated and repurposed on the painting's completion, to be played back sequentially as a piece of slow technology [1]. One of the design proposals stood out as being particularly compelling to Walsh. A mobile phone application would augment the painting with images of previous versions, so that gallery visitors might explore them in the presence of the original artwork. Walsh felt that in addition to exposing his process, such an application would be a visually and experientially interesting piece in its own right. Excited by the idea Walsh suggested the name Repentir to reference existing art historical and critical practice.

Repentir

In order to further explore this design proposal and the concepts that arose during our inquiry, the research team developed the Repentir mobile application. Repentir allows gallery visitors to view the images captured during the creation of Transamerica. To use Repentir, the user takes a photograph of the painting or

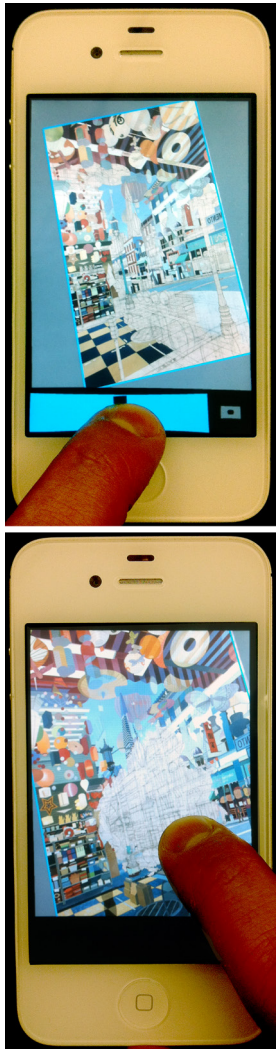


Figure 2. Repentir's slide (top) and rub (bottom) interaction techniques.

a region of the painting. The section of the painting in the photograph is identified and its position is tracked to overlay images of previous versions of the work (Figure 2). The user can then use one of two interaction techniques (slide and rub) to reveal the hidden layers of the painting. This allows the user to make their own image by effectively removing layers of paint to reveal previous versions right back to the under drawing and blank canvas. Our current prototype of Repentir is implemented on an Apple iPhone 4S.

Identifying and Tracking the Painting

A scale invariant image feature matching approach is used to identify the painting and track its position within the photograph. We based this approach upon work by Herbert et al. that used a similar technique to determine the position of a mobile device with respect to a public display [6].

Key features within the photograph taken by the user are identified using the Scale Invariant Feature Transform (SIFT) algorithm [8]. Descriptors for these features are then computed using a SIFT-based descriptor extractor. Using these descriptors, the features are compared with an additional set of features computed from a known image of the paining to identify matches (i.e. features that refer to the same position in both images). If the number of matches found is greater than a threshold, it is determined that the paining has been successfully identified in the photograph taken by the user. When identified, the differences between the positions of each feature in the matched pairs are used to compute a homography. This homography describes the projective transformation between the two images and, therefore, can be used to overlay the images of previous versions onto the painting in the user's photograph.

While computationally expensive, this approach was chosen over alternative methods, such as tracking the painting's frame [4] or adjacent fiducial markers [7], for one important reason. That is, the approach is able to identify and determine the position of the painting within the photograph, even if the user captures only a small region of the painting. This is crucial for Repentir as it allows gallery visitors to *get up close to* the painting and inspect the hidden layers beneath particular regions or features.

Browsing Previous Versions of the Painting

Once the painting has been identified and tracked, the application displays the original photograph with an image of a previous version of the painting overlaid onto it. To achieve this, the homography computed in the tracking phase is used to transform the corners of the overlaid image such that they correspond with the corners of the painting in the photograph.

The user is able to browse through the different hidden layers of the painting using two interaction techniques. The first of these, slide, allows the user to simply select between a series of previous versions of the painting using a slider at the bottom of the screen. The images are ordered sequentially, such that when the slider is at the far left, the earliest version of the painting is shown and when it is at the far right, the last version is shown.

The second interaction technique, rub, allows the user to reveal the hidden layers behind the painting by rubbing a particular area of the screen. As a user rubs



Figure 3. Exhibition shots of Repentir, using ceiling-suspended print of Transamerica.

an area, pixels from older versions of the painting are revealed under his or her finger as if they are rubbing away layers of paint. Consequently, the user is able to reveal the layers behind partial areas of the image and view pixels from multiple versions of the painting simultaneously. To achieve this partial rendering of layers, the image overlaid onto the painting is dynamically updated to display pixels from different versions of the painting, based upon which areas the user has rubbed. We envisage that future versions of the application might allow gallery visitors to create their own printable *versions* of the painting while using the rub technique.

In the Gallery

To explore how Repentir affects how gallery visitors experience Walsh's work, we intend to install the application alongside Transamerica at a number of exhibitions, including one at the gallery where Walsh's work is primarily displayed and sold. At a pre-launch test of Repentir in December 2012 (Figure 3), we utilised a print of Transamerica, as the work was still unfinished. However, in future exhibitions we intend to feature the original oil painting.

Informal discussions with gallery visitors who used Repentir during the aforementioned pre-launch exhibition highlighted how the application allowed gallery visitors to easily explore the hidden layers beneath the surface of Transamerica. Users found the application extremely engaging. Although most visitors at the pre-launch test were computer science researchers the piece elicited comments such as "*That's magic! How do you do that?*" Other visitors noted that Repentir has the potential to introduce a new and compelling aspect to the experience of viewing paintings in the gallery setting.

Acknowledgements

Many thanks go to the artist, Nathan Walsh, for his close involvement and to the Bernarducci Meisel Gallery. The EPSRC Digital Originals project and the SiDE RCUK Digital Economy Research Hub funded this research.

References

[1] Briggs, J. and Blythe, M. No Oil Painting: digital originals and slow prints. *Slow Technology: Critical Reflection and Future Directions (DIS '12 Workshop).*

[2] Blythe, M., Briggs, J., Hook, J., Wright, P. and Olivier, P. Unlimited Editions: Three Approaches to the Dissemination and Display of Digital Art. CHI '13, ACM, in press.

[3] Blythe, M., Briggs, J., Olivier, P. and Hook, J. Digital Originals: Reproduction as a Space for Design. *NordiCHI '12*, ACM, 1–10.

[4] Boring, S., Baur, D., Butz, A., Gustafson, S. and Baudisch, P. Touch projector: mobile interaction through video. *CHI '10,* ACM, 2287–2296.

[5] EPSRC Digital Originals project details available at: http://gow.epsrc.ac.uk/NGBOViewGrant.aspx?GrantRef=EP/I032088/1

[6] Herbert, L., Pears, N., Jackson, D. and Olivier, P. Mobile Device and Intelligent Display Interaction via Scale-Invariant Image Feature Matching. *PECCS '11*, 1–8.

[7] Kato, H. and Billinghurst, M. Marker Tracking and HMD Calibration for a Video-based Augmented Reality Conferencing System. *IWAR '99*, 85–94.

[8] Lowe, D. Object recognition from local scale-invariant features. *ICCV '99*. IEEE, 1150–1157.