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Maintaining Authenticity: Transferring patina from the real world to the digital to retain narrative value

Introduction

This research is concerned with utilising new technologies to harvest existing narrative, symbolic and emotive value for use in a digital environment enabling 'emotional durability' (Chapman 2005) in future design. The projects discussed in this paper have been conducted as part of PhD research by Rosemary Wallin into 'Technology for Sustainable Luxury' at University of the Arts London, and visual effects technology research undertaken by Florian Stephens at University of West London.

Luxury goods, digital animation and perfection

Luxury, as a concept and field, is of interest as it speaks about the values of a given society. The historian Maxine Berg refers to luxury in the eighteenth century as a 'catalyst and a signpost of social and intellectual change' (Berg 2003). In a contemporary context, high-end image making and advertising give luxury goods, bags and shoes a plastic, hyper-real, glossy surface, which has now become generically associated with luxury products. Leather is one of the materials associated with luxury goods. Selected from the highest grade, un-marked and homogeneous, all trace of the animal skin from which it is made obliterated, luxury leathers are expensive in financial, ethical and environmental terms.

By contrast, this homogeneity of surface is a source of frustration in the world of 3D animation. Hours are spent re-creating the detritus of human life. Wear and tear patina is applied to objects intended to look real, which in their raw digital form would otherwise look too perfect and therefore unrealistic.

Whilst the world of luxury goods attempts to remove all trace of reality from its vision of perfection, animators are trying desperately to re-introduce it. The point of convergence for both these practices is the skin or surface, and the site of value is the patina.

Patina and value – A historical context

Before fashion became the predominant cultural system of status, there was a system of status in England which utilised similarly encoded and nuanced information provided by patina. Novelty and the ever-changing tastes of fashion are a product of a consumer society, which exploded in the eighteenth century. Before this, English society revolved around family, honour and the transition from what was known as ungentle to gentle standing – to become a gentleman. This process followed a 'five generation' rule (Ferne 1586). Patina was one of the indicators that possessions – and therefore wealth – had been in the family for a long period of time. Patina helped to maintain the social hierarchy by converting money into status very slowly.

The PhD research, which provides a context for part of this paper, examines the potential of patina as a site of value linking objects and people. The value of objects and our relationship to them is particularly important in the sphere of sustainable design. For an object to be traded as authentic or preserved in a museum collection, it must have the signs across its surface of the narrative denoting its age and heritage. Similarly, for products to be kept, saved, and cherished by consumers rather than quickly discarded due to perceived obsolescence, we need to find systems of design which both activate and harness the bonds that connect us to the objects we own and use. Value is not simply housed in the cost of a precious material or the quality of workmanship; beautifully crafted work is destroyed every day to make way for the new or fashionable. Value is attributed through a network or constellation of qualities, of which materiality and craftsmanship may be important, but not exclusive aspects.

Figure 1. 'Patina provided individuals with a visual manner of determining where families stood in the process of gentrification and mobility.' (McCracken 1988)

The historic emphasis on slowness and inter-generational ownership is in many ways echoed in the move towards sustainable design thinking. Perhaps the notion of patina deserves re-examination in this new light.

Could patina help to preserve an emotional bond, and if so, how could patina be utilised in a sustainable design process today?

Patina in 3D animation

In the technology and design of animation, sustainable principles are less relevant. However, patina is also a tool for evoking emotive and narrative quality. Patina is a physical quality of material culture that is used to establish authenticity. What is patina in a digital context? In the field of Computer Generated Imagery (CGI) the author Bill Fleming (1999) states that the following qualities should be considered to represent patina:

- Clutter and chaos
- Personality and expectations
- Believability
- Surface texture
- Flaws, scratches and dings
- Dirt, dust and rust

Digital artifacts are by their nature sharp, clean, crisp and do not age in the same way as physical products. In their purest construct, they lack any kind of patina, texture or surface quality. An analogy can be made with the advent of digital photography in the later part of the twentieth century. According to Christopher Nolan, for all its promise, digital filmmaking appeared soulless (Kenneally 2012) and is too squeaky clean. Digital images lack the warmth of analogue, or the '"film look" itself, soft grainy, somewhat blurry appearance of a photographic image which is so different from the harsh and flat image of a video camera or the too clean perfect image of computer graphics' (Manovich 2002).

The noise and grain of analogue might be seen as a form of patina on the film negative, and therefore something digital images lack. Indeed, if true digital patina exists (as an inherent property in a digital context, in the same way continuous tone is an inherent quality of film), it might be seen to be the result of some image degradation, such as jpeg compression. Therefore digital patina, showing the status or property of the surface or form, must be applied, and this can be seen in the popularity of 'apps' such as Instagram, which apply a retro looking filter to the image to recreate an analogue aesthetic.

Virtual patina has played a vital role in producing convincing CGI for all aspects of 3D modelling and scene generation. Early in the evolution of 3D animation, it was clear that to increase surface detail more polygon data was required, but this needed additional computing power. Later bitmap images were 'mapped' to 3D objects in the form of textures with other material qualities, such as glossiness or reflectivity. Reality recreation became a secondary but parallel craft, as once a scene was modelled it needed to be dressed with textures such as dirt, dust and rust via 'photorealistic surfacing techniques' as there are 'very few clean surfaces in reality' (Flemming 1999).

Authenticity

The *Oxford English Dictionary* in part defines the word authentic as:

- Of undisputed origin and not a copy; genuine
- Made or done in the traditional or original way, or in a way that faithfully resembles an original
- Based on facts; accurate or reliable

Authenticity is a term used widely in the field of luxury, craft and making. It has become part of the mythology surrounding notions of heritage, tradition and tacit skill. At what stage, though, does a process or a way of working become a tradition? At some point most processes used in the making of an object were new. All craftspeople evolve their skills and tools to suit their individual style of working, and most will incorporate new elements when appropriate without concern that they are losing the authenticity or integrity of the piece they are making.

Computer-aided design (CAD) and manufacture (CAM), and 3D printing, being a relatively new technology, can suffer from a perceived inauthenticity. Comparing a piece of rapid prototyping to a hand-crafted wooden object does not appear to be comparing like with like, no matter how long the CAD model took to draw and render. The material quality of the objects produced may seem low grade, in some cases, when compared to a sophisticated handcrafted object. The democratising element has also been widely publicised. With

a maker-bot machine now retailing at less than the price of the latest laptop, the possibilities for everyone to 3D print their own designs appear to be endless. However, the sites where enthusiasts can upload their creations display unappealing pieces of jewellery and trivia. Such sites and communities have a clear focus on the process of 3D printing, where the end product seems of lesser importance than the process itself. The resulting plastic objects often lack the appeal and commitment of something well crafted and made by hand.

As part of her MPhil at the RCA in 1998, Wallin utilised CAD and rapid prototyping technology to re-design an archetypal product along closed loop principles. Stereo-lithography models were produced which then needed to be finished with car filler and sanded by hand to remove the traces of the support structures around the forms. The additional hand-skills of model making were necessary to achieve a high level of surface finish. Rapid Prototyping sector has evolved since then into Additive Manufacturing, with the machines now using complex materials to a far higher quality, but the hand finishing of surfaces is still required today.

In the last decade, specialists have begun to use both hardware and software with more subtlety and nuance, to effectively 'craft' using the technology. In 2010 the Crafts Council held an exhibition called 'LAB Craft: Digital Adventures in Contemporary Craft' which looked at the idea of a new craftsperson fully engaging with the opportunities of digital technology to 'move beyond the limitations of the hand' (Crafts Council 2010). (CraftsCouncil, 2010) (CraftsCouncil, 2010) Makers such as Nina Tolstrup, Drummond Masterton and Tavs Jorgensen showed work which demonstrated a way of using new technology with a craft maker's sensibility.

The V&A and the Crafts Council followed with 'The Power of Making' in 2011 which, although not directly concerned with technology, did show new and traditional technologies given equal footing in a bid to problem-solve using the categories of adding, subtracting and transforming.

Research clusters such as Autonomatic at University College Falmouth continue to push the boundaries of what crafting digital technology could mean, including research into how to overcome, subvert and individuate the standardising process that CAD software necessarily operates, and develop human centred interfaces for 3D design tools.

Screen based design, 3D modelling and animation has also evolved in recent years. Digital animation has grown from a relatively niche market to large-scale productions – such as Pixar's *Toy Story* movies. Similarly, computer games now feel more like films, in terms of their use of cinematography, narrative structure and a 'filmic' quality. The level of detail and commitment 'digital craftspeople' apply to virtual creation is equivalent to craft in the physical world. At the time of writing the fifth instalment of Rockstar Games' *Grand Theft Auto* video game series has been released to much critical acclaim. Despite controversy about its content (violence, etc.), the game is genuinely beautiful and exquisitely detailed (Rose 2013)(Rose, 2013)(Rose, 2013). From the dazzling sunsets to the level of detail and patina in the sidewalks, digital 'patina' has been crafted to photographic level. The accepted process – or workflow – in this field is to 'build from scratch' or replicate the physical, but the question remains if this is in fact the only way to evoke an authentic experience.

Figure 2. *Grand Theft Auto 5* – Rock Star Games

If an object or a space can be authentic by faithfully resembling an original, this paper looks at two sets of three experiments to replicate and utilise an original object or space as a starting point for design.

Sustainability and emotional durability

> … design, in any guise, sustainable or otherwise, is instead the root of the environmental crisis, and that only when the scope of design's complicity is understood, can anything like 'sustainable' human environments be conceived. (Hill 2008)

This was the controversial statement at the beginning of Glen Hill's 2008 book *Design, Heidegger, and the Earth*. The role of the designer has never been under such attack. If Victor Papanek, the grandfather of sustainable design principles, was not exactly complimentary in 1971, he instead opted for a call to arms to designers to become real world problem-solvers rather than merely stylists. Hill (2008) takes the argument further, making designers fully responsible by describing design as the 'engine of consumption'. (Hill, 2008)

Sustainable design principles are no longer new, with architects, vehicle and product designers all being forced to adapt, as corporate social responsibility (CSR) policy becomes the norm for every large corporation. However, sustainable design principles deal with how we consume products now, and can fail to radically re-imagine the relationships between designer, producer, consumer and waste beyond the now well established principle of closed-loop manufacture and recycling.

In 2005 Jonathan Chapman used the phrase 'emotional durability' to describe a new way of designing products that would enable consumers to feel more attached to the things they buy, reduce the consumption cycle and avert an imminent environmental crisis. He talked about the need to design 'cherishability' into products, and outlined proposed strategies for allowing 'the relationship between subject and object to become evolutionary' (Chapman 2005). (Chapman, 2005) (Chapman, 2005) Designers, he said, have a responsibility to produce goods which will not be quickly discarded but will evolve and change with the user without impacting further on precious finite resources.

A deeper analysis of our emotional attachment to objects could reveal some starting points for further design experimentation, to move beyond sustainable design principles into proposals for radical sustainable design strategy

Harvesting value – Skinning, casting and transforming

To create a pelt is to take the skin of an animal, with all that is attached to it in terms of hair, wool or fur. The origin of the word 'pelt' is from the old French word *pel* or skin and the Latin *pellis*. The skin houses both information and value. An animal pelt can be used to make a fur coat, for example, whilst the skin, once stripped of hair, wool or fur, can be used as leather, in products as diverse as shoes, bags and car interiors. Furs and skins are used widely in the luxury industry due to their literal expense and semantic value as a signifier of wealth. Some designers such as Stella McCartney or Beyond Skin refuse to use leather in their collections, believing that man-made materials will provide a more sustainable product. However, the processes involved in making many faux-leather materials can, in fact, be even more damaging to the environment than ethically produced leather, so the issue is complex.

Figure 3. Martin Margiela, *Maison*

Designer Martin Margiela has played with the concepts of skins, patina, trompe-l'oeil and re-cycling in his deconstructivist approach to clothing collections. He might print one type of garment onto another or one material onto another as well as re-fashioning discarded items into new configurations, subverting their original use into another. He deliberately plays with the meaning of old and new, and directly manipulates fashion's self-referential habit of copying and re-interpreting ideas. In designing the interior of the Maison Champs Elysees Hotel, ornate antique doors were screen-printed onto new ones, and a modern interior was decorated with the greyscale-flattened outlines of the past.

Figure 4. Rachel Whiteread, *House* 1993

What is left behind, the remainder and human traces, are regularly seen in fine art. In 1991 Gabriel Orozco measured his weight in black plasticine and rolled the resulting large ball in the streets to take the imprint of the surfaces it rolled across. The piece was called *Yielding Stone* and created a literal and metaphorical bridge, imprinting the space between the artist and the world he inhabits.

Rachel Whiteread's controversial 1993 sculpture, *House*, was a cast of the inside of a Victorian terraced house in East London. By casting the interior, Whiteread collected the human traces left in the space and transformed them from positive to negative, negative to positive, and in doing so created new meaning.

Figure 5. Jay Watson, *Linger a Little Longer* 2011

New technologies have allowed human traces to be used in new, dynamic and interactive ways. In 2011 Jay Watson designed a table and bench with a heat sensitive coating, which responds to not only the food and utensils used on its surface but also the heat of the human bodies sitting at the table. The marks fade over time but leave a ghostly imprint of the people and activities, which have both inhabited and taken place upon it.

Whilst Margeila with his trompe-l'oeil prints is in a certain sense using the idea of a skin of an original garment or space, the effect remains rather 2D, photographic and flat. Whiteread, however, by casting objects and spaces in three dimensions takes everything with her. Refusing to be satisfied with a flat representation, she wants to preserve the entire void and essence of a space. One removes data from the original to leave an imprint while the other grapples with the entire complexity and topology.

This duality is present in the two digital approaches re-appropriating the surface of the scanned object in Experiment One. The first uses an imprint method to re-create a faux-topology and the second uses all the information available in an advanced digital sculpting package widely used in CGI.

Reality capture and replication

Throughout history artists have tried to render reality in a variety of mediums. This has traditionally been comprised of figurative painting and sculpture, where a master craftsman studied his subject and acted as the vehicle from which a facsimile was produced. Typically, painters were commissioned to produce artworks by patrons for cultural, religious or social financial status.

There is much contemporary evidence that artists of the Renaissance increasingly turned to science to aid the development of accurate perspective in two-dimensional artworks. The Hockney-Falco thesis, a theory maintained by the artist David Hockney and condensed matter physicist Charles M. Falco, argues that rapid advances in 'realism and accuracy' between the fourteenth and fifteenth centuries were due to the use of optical devices such as the camera obscura and curved lenses (Hockney and Falco 2003). (Hockney & Falco, 2003)(Hockney & Falco, 2003) Hockney's theories are still strongly contested, in part because there is little physical evidence to support them. However, they remain important to this paper by providing an early reference to the use of lenses in 'capturing reality' via a drawing made over a projection, well before the advent of photography.

A further reference in the history of reality-capture is provided by the engineer James Watt. Watt invented the first device to copy documents as some

intriguing 'sculpture duplicating machines' (Schils 2008). (Schils, 2008)(Schils, 2008)The machines where later perfected by Benjamin Cheverton, who adapted them to copy, enlarge or reduce sculptures accurately. The machine worked to a similar principle of the 2D pantograph – a device used for exactly copying drawn images or text. This copying machine bore similarities to the modern day CNC milling process, and the 3D pantograph approach is not dissimilar to Contact 3D scanners.

Current 3D scanning processes may now be maturing to allow for ease of use and increased accuracy. Both Autodesk and Maker-bot seem intent on reaching the goal of replication for a domestic end-user.

The evolution of contemporary 3D scanning

Whilst scanning objects for the purposes of reverse engineering and digital replication has been commonly used in engineering and product design companies for decades, two contemporary examples show a level of detail and surface capture particularly relevant to this paper.

- *Factum Arte* – a group of artists and conservation specialists renown for cutting-edge use of digital technologies
- *Shipping Galleries 3D Model* – An extensive laser scan commissioned by the Science Museum London

Factum Arte

> One of Factum Arte's core strengths is obsessive interest in the qualities that make things specifically what they are. (Lowe 2013)

Factum Arte are a digital conservation company who specialise in historical works of art. They use non-contact 3D laser scanning and digital photography to collect massive amounts of data on their subjects, which are then translated into 2D and 3D for 'the production of facsimiles as part of a coherent approach to preservation and dissemination' (Factum Arte 2013). (Factum Arte, 2013) Their work is at the forefront of technological processes used in conservation and fine art. Their approach begins to redefine the qualities that make up a surface patina and its importance when making an authentic reproduction.

Adam Lowe, Director of Factum Arte, states:

> For me the key is that we are interested in surface. We are interested in the noise and peculiarities and details of a surface. But most three dimensional applications are interested in shape and sacrifice the subtle details of surface. (Lowe 2013)

Figure 6: Factum Arte

This rigorous attention to detail, viewing the surface as of equal importance to its overall shape and form, has opened up intriguing possibilities for future collection of physical reality data. In a sense, it might be suggested that these rich, full-colour, detailed scans are a form of '3D photography'. In the past the most accurate method of recording an object might have been achieved by taking a photograph and capturing the light in the scene. Now it is possible to capture large sets of three-dimensional and colour data simultaneously, providing a full virtual experience of a scene or object.

In its book *Mediating Matter – Returning the Digital to the Physical World*, Factum Arte Foundation states that it is:

> dedicated to the development and use of non-contact high-resolution digital recording as part of a coherent approach to the preservation, dissemination and public exhibition of diverse types of cultural artifacts. (Factum Foundation 2012)

The Science Museum, London – Shipping Galleries laser scan

In 2012 the decision was made to close the Shipping Galleries in the Science Museum London, in order to make way for new exhibits. The collection of maritime models and artifacts had been on display since 1963, and before the models entered storage

the Science Museum made the decision to have the entire space laser scanned. The Shipping Galleries curator describes the reasoning and experience of scanning the space:

> We wanted some way to preserve the old shipping galleries, and I was really excited when we got the chance to have the display laser scanned … now we can make a virtual model of the galleries, we can see them in an entirely new way. It's a unique permanent record of a unique and historic exhibition. It lets us fly through the galleries. (Roney 2013)

Watching the animated fly-through of the Shipping Galleries 3D model is an ethereal experience. The entire geography of the space is captured and at points the model is transparent, allowing for multiple levels to be seen. ScanLab, who carried out the scanning process in conjunction with University College London, captured 1800 objects from the display in high detail.

Figure 7. Shipping Galleries

The use of laser or photogrammetric processes to document artifacts and objects of historic importance is becoming a real alternative to more traditional routes such as photography or video. It is clear that these cutting edge techniques provide an unparalleled way of capturing the most authentic, non-physical 3D forms as well as the patina of surfaces. This is true particularly on large-scale projects, where taking physical moulds is impossible. For this paper the authors were interested in undertaking experiments using low cost alternatives and software that is easily accessible by those who have little 3D modelling, scanning and fabrication experience.

This paper presents two sets of three practice-based approaches to storing and transferring patina from an original object or space, utilising high resolution scanning, photogrammetry, mobile applications and 3D print technologies. The objective is not merely accuracy but the evocation of the emotive data connecting the digital and physical realm.

Experiment One – Object

Undertaken by: Rosemary Wallin

Objectives

The purpose of the experiment to was to capture and utilise patina from an existing object using 3D scanning technologies and computer-aided design (CAD) software packages. The investigation was multi-factoral, in attempting to look simultaneously at materiality in terms of aesthetic quality and sustainability, emotive value as well as transforming the use-value of the object.

The key objectives were:

- Harvest the emotive value of a family heirloom to encourage emotional durability
- Transform the value of an unsustainable material into a sustainable one
- Reconfigure a historic object to modern-day relevance
- Explore the boundaries surrounding the materiality of an object by connecting the digital and physical realm

Figure 8. The original crocodile skin suitcase

The object chosen was a small crocodile leather suitcase made in the late nineteenth century by North West Tannery Co Cawnpore (now Kanpur) with nickel-plated fittings and brown cotton lining. The case has value to a particular family, as the crocodile used in its production was shot by the great grandfather of the current generation. This connects the case to a particular time in history, a particular

person and a particular event. The case, however aesthetically appealing, has fallen into disuse, as it is small, heavy and unsuitable in a contemporary working context. It also represents – by current standards – an unappealing and unsustainable method of production.

Could the skin be harvested and re-used in a sustainable context, and could the narrative and emotive value held in the patina be retained (Alberge 2013) (Alberge, 2013) whilst simultaneously re-making the object into a useful, modern equivalent product?

Creating a 'digital pelt'

Before the skin could be re-used, it first had to be captured. This was done with a scan made using a nextengine scanner, which produced a high resolution PLY file. The higher the resolution of the scan, the more surface detail information is retained. Then the case was unwrapped in 3D studio max by taking the 3D scanned data and using an unwrapping tool, which flattens it into a template. The digital skin or pelt is now data – 4.5 million polygons – that can be used in a number of ways. This unwrapping tool is commonly used in animation to make more believable surfaces for complex 3D objects where planear mapping would lead to distortion (i.e.:imagine wrapping paper over a complicated shape).

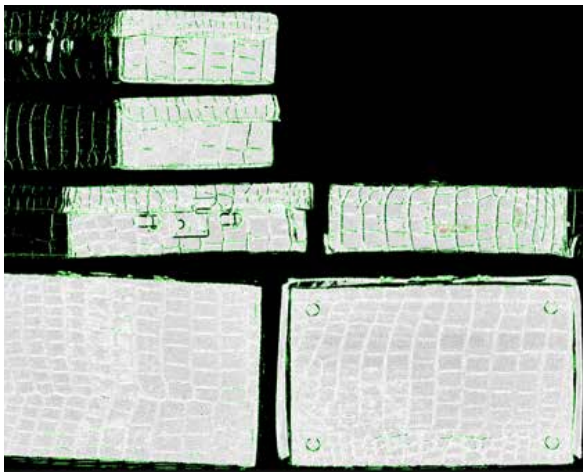

Figure 9. The unwrapped 2D case as a high-density model

Methods

Displacement mapping – 'the imprint method'

3D Studio Max

The unwrapped case or 'digital pelt' was a huge file, and in 3D Studio Max very slow to manipulate, repeatedly crashing the computer. Whilst a 'digital pelt' had been created, it was unusable in a software which uses vertex and polygons (4.5 million is very high density). At this stage, another approach was attempted – that of displacement mapping. Here, a 2D image of the unwrapped case was created in Photoshop, which allows the software to convert the greyscale values to create a topology. This is not the same as the original topology of the patina, but it is visually similar. The new 'skin' can then be wrapped around another 3D object – in this case a CAD model of a laptop case (the modern-day equivalent, perhaps, of the small suitcase). The result has a skin-like effect and mimics the texture of the original case. The case has been converted from the original to a 3D scan, flattened into a 2D image and then re-formed into a 3D object. When 3D printed, the loss of patina quality is evident, but an interesting new texture is created.

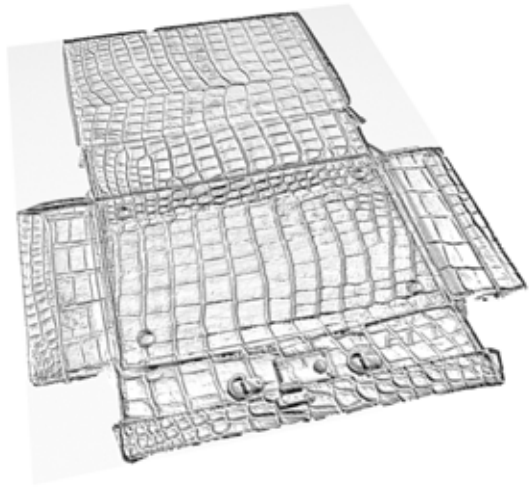

Figure 10. Displacement mapping the unwrapped case

Digital sculpting

ZBrush

ZBrush is an alternative CAD software which is capable of using the high resolution scan and sculpting the mesh around a new 3D model without difficulty. The software was created to work with high density meshes (up to a billion polygons) and is used in CGI (computer-generated imagery), games, movies and sculpture. Zbrush is a popular tool in digital aesthetics but is not as accurate as other softwares in terms of measurement (e.g. Solid Works

–a solid modeller, used by engineers for its accuracy). Zbrush uses pixols rather than pixels, which are able to carry more information than simply the x and y position. They can contain light, colour, depth, material and orientation information in addition. The high resolution 3D scan of the case was imported into Zbrush and the bottom of the case cropped and removed as excess material.

The top of the case was placed over the 3D model and the laptop case was projected on top of the skin in order to acquire the same volume and topology. Twelve million polygons were active during the sculpting process, and the skin took the new form in a manner similar to the leather lasting process used in the manufacture of shoes. As the object or 'digital pelt' remains 3D from the scanning to the sculpting, there is little or no degradation of patina quality. A 3D printout of the case demonstrates the more accurate rendering of the patina quality on the new form.

Figure 11. 3D printed model of the Zbrush sculpted case

Traditional casting process

Lost wax and silicon moulding

To contrast with the digital processes, a traditional process was employed to achieve the same result. Used in the production of sculpture and jewellery, lost-wax casting is an ancient process, versions of which can be traced back 5,000 years. In a sculpture foundry, a silicon mould was made of the original, enabling a wax to be made. This was surrounded by fireproof material and the mould heated so that the wax is 'lost', leaving a cavity in its place. To harvest the skin of the crocodile case a silicon mould was made of the surface, and a series of wax 'skins' were made from this. These are the most accurate copies of the patina, as even the highest resolution scanning results in some loss of information. The wax 'skins' can now be heated and moulded to a new form and an aluminium press mould can be made.

Figure 12. A wax 'skin' being taken from the mould

Transforming use and material

Using the silicon mould and the potential of the aluminium press mould, experimentation can be undertaken creating the patina surface onto alternative materials. Biopolymer experiments yielded promising results, with the surface of the original case successfully transposed onto a new useable product form in a new sustainable material.

Figure 13. The re-formed case in sustainable materials

Findings and conclusions

Displacement mapping – 'the imprint method' – 3D Studio Max

Displacement mapping provides a quick and simple method for using patina on a new surface. It can be applied to an infinite variety of forms and does not require a 3D scan but can be realised from a 2D source (such as a photograph). However, there is a loss of quality and detail, as well as a uniformity across the surface which might not exist on the real object as it is essentially a re-creation of the surface rather than a direct scan of it.

Digital sculpting – ZBrush

This provides a much more detailed solution and retains the patina surface in a more direct way (the surface is never flattened into 2D but retains all the data from the scan). However, the sculpting process is more time consuming and, as the software is more specialised, greater expertise is required to achieve a satisfactory result. Despite the learning curve with such complex software, the advantages are immense, as the data can be used and manipulated without limitation. The potential for a 'digital pelt' to be fully exploited into other product possibilities is very exciting.

Traditional casting process

The lost wax method uses silicon moulding to take the detail of the patina or the form of the object, or both. Whilst this method provided the most accurate method of harvesting the information (superior to the scanned data) it was also very time consuming, employed multiple processes and was not fully interactive like the digital process. Once each wax skin had been used, it was necessary to create another, as each could only be used once. There was, however, partly as result of the time involved, and partly due to the nature of the material, a more direct intimacy between the material and the maker, which is undoubtedly lost between the computer screen and the software user. It is arguable whether this intimacy translates to the final object, but the tacit knowledge involved in the physical act of moulding the wax skins is certainly replicated in the skill of the software user in the digital process.

Applications – Future luxury

This experiment was concerned with the value of a luxury item and whether it was possible to take an existing object and harvest the narrative and emotive value whilst transforming some of those values no longer relevant in a sustainable context. The technology is certainly available to do this in the form of scanning, sculpting and 3D printing processes, as well as in material advances. However, beyond these answers, the research throws up some further areas to be explored:

- Could future consumers either gather data themselves, or use existing data in the form of objects of significance related to a person or an event (or both) as a starting point for creating bespoke goods, with a high degree of emotional attachment?
- Will consumers become active participants in the creation of their own luxury goods?
- Might luxury brands become service providers, providing the means to produce rather than being the producers?
- Could the reclamation of patina provide a system of value for future luxury, designed for inter-generational use, rather than obsolescence?

Experiment Two – Space

Undertaken by: Florian Stephens

Objectives

The purpose of the experiment was to investigate the use of 3D scanning technologies to capture densely patinated surfaces and spaces. The intention was to build upon and complement existing 3D animation practice and research by focusing on a number of key objectives – listed below:

- To democratise the process via inexpensive and readily available scanning technology
- To increase the authenticity and emotive potential of digitally-reproduced environments
- To potentially offer a faster, more accurate and efficient workflow to existing 3D animation practices

Methods

In order to undertake the experiment a suitable subject was needed. It was decided that an interior space was needed, in contrast to experiment one, which was object focused. A richly patinated space was sought and selected for irregular form and surfaces. The resulting space chosen was a room in a seventeenth-century Cumbrian farmhouse. The test was to recreate the interior using three 3D modelling and reality capture methods.

Figure 14. Space

3D modelling – Industry standard workflow with 3DS Max

A section of the space was recreated in 3DS Max. This was modelled by eye with measurements and photographic reference (the photographs were also used to recreate the texture). The process of modelling all the objects in the scene took approximately five hours to complete; 3D rendering was another two hours.

Photogrammetry – using Autodesk Catch 123D iPhone application and desktop software

Photographs were taken 'freehand' and uploaded to the Autodesk cloud systems to create 3D models using the principle of photogrammetry – which is the practice of determining the geometric properties of objects from photographic images. The model was available to download several hours later.

Handheld Laser Scan–- Microsoft Kinect Sensor and Skanect capture software

The Microsoft Kinect is a sensor accessory for the Microsoft Xbox, whereby a player can interact with games via body movements. Increasingly, Kinect is used by developers to create inexpensive 3D laser scanning solutions. Therefore, for the third method, a Kinect was used in conjunction with 'Skanect' – a reality capture software.

Findings and conclusions

Traditional 3D modelling

Using software such as 3DS Max to produce architectural space is an accepted workflow, used regularly in the 3D animation industry. Other benefits include-the user's ability to model any form. 3D models are efficient to work with and can be modified to client needs. Whilst the workflow can be fast, the software is complex and an experienced artist is required to operate it. It can also be inaccurate – both visually and spatially. The patina needs to be recreated – indeed all the qualities discussed in this paper that make up surface patina must be painstakingly analysed and reproduced by hand with the addition of Adobe Photoshop.

Figure 15. 3D modelling

Photogrammetry

The Autodesk 123D Catch software suite requires minimal technical experience to operate. The iPhone application consists of a two-step operation – the user photographs the subject from all angles and, after review, the images are uploaded to the Autodesk Cloud server for processing. When the models are ready they are viewed in software and exported to alternative file formats and uses. This method showed some initial promise, especially with individual objects – accuracy of geometry and patina captured was extremely good on an object basis. However, larger spaces and the subject interior were much more problematic – whilst some areas were accurately captured, many others had missing sections and distortion, and an efficient workflow eluded the experiment.

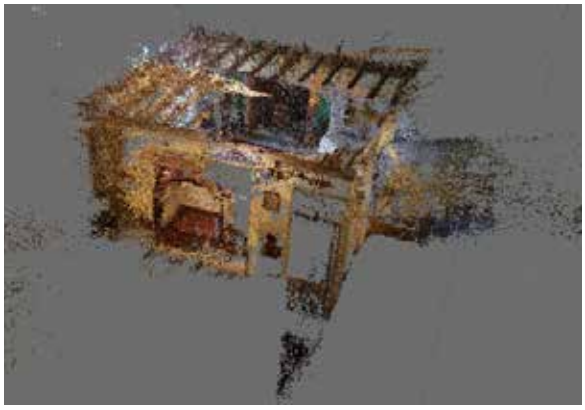

Figure 16. Photogrammetry – Space

Laser scan

From its first use it was clear that the Microsoft Kinect–Skanect setup was going to provide the most accurate and efficient 3D scanning workflow. The Kinect was by far the most immediate and easy to use method; both 3D modelling and photogrammetry methods did not provide particularly fast results. In comparison, the Kinect could be swept across a surface, which would materialise in the software as a fully textured 3D model almost immediately,

although the room needed to be captured in sections and pieced together at a later stage. The method provided accurate spatial capture – although low resolution in parts, in general the patina was authentically replicated. With this procedure the emotive qualities of patina seemed to come through the scanning process and were somehow held digitally in the final artefact. Nevertheless, there were inherent drawbacks to this method; it produced heavy 3D models with large files, which would hinder potential digital applications. This is due to the difficulty in manipulating massive amounts of 3D data for animation and games purposes. Unlike the 3D modelling approach, the files were inefficient.

Figure 17. Kinect laser scan – Space

Applications – Future visualisation

The experiment was in essence a comparison of three forms of digital making, with a focus on 'reality capture technologies'. The following questions were raised by the research:

- Could scanned data provide an alternative to traditional forms of 3D modelling, photography and film as a way of documenting a space or environment?
- Will the process provide new ways of capturing essence, memory and place?
- Could this research allow for a re-evaluation of what a surface is in a digital context?
- Does this research offer new pathways for 3D content generation in video games, film and virtual spaces?

Conclusion

This paper has uncovered a number of potential areas for development of practice-based digital making and its relationship to traditional craft. It is clear that digital patina is more than just a virtual reproduction of its physical cousin; it is a site of emotive, poetic and narrative quality. This was especially true in the object experiment, where scanned data was reformed into a new artifact, whilst retaining the history and character of the original surface. The surface is the meeting point where digital and physical worlds converge and patina is the rich, accrued narrative and emotive value housed within its topology.

With current technology we can scan an object and replicate its form, but the pursuit of the qualities that make up patina are key to investigations about the meaning of authenticity in a digital environment. Fast developing scanning technologies and 3D sculpting applications such as Zbrush have prompted an intense interest in digital authenticity. This can also be seen in headlining projects such as the Van Gogh Museum's commercial replication of a number of paintings using an advanced 3D printing technology by Fujifilm. The replica Van Goghs are claimed to be indistinguishable from the originals. These duplicates are called 'relievos', super-accurate reproductions, even extending to the frame and the back of the painting. Every relievo is numbered and approved by a museum curator (Alberge 2013). (Alberge, 2013) Where, exactly, is the value housed in this perfect replica when situated next to the original handmade work of art?

> When we persist in trying to substitute virtual experiences for embodied ones, we end up with the worst of both worlds. Digitisation speeds the flow of data, but impoverishes our lived experience. (Thakara 2006) (Thakara, 2006)

Is it really the case that the digital world must impoverish our lived experience? Is it not possible that with considered design strategy a complex conversation between the two might allow

for a deeper, more enriched experience? The contemporary production of sculpture provides a good example of an industry where craft and technology, the physical and the digital, work in tandem. Objects travel between the sculptor's hand and the computer screen, the virtual and the bronze, without either lessening the value of the other, but supplementing, adding to and enabling each other. This crossing back and forth, never before so easily and quickly achieved, has implications for all areas of design. The diagram below shows the divergent areas of the authors' work, and how this paper is situated in the intersection, a new area of practice-based research. The experiments and examples highlighted in this paper all involve a fundamental 'de-materialisation, transformation and re-materialisation' (Factum Foundation 2012) (Factum Foundation, 2012) process which conceptually provides a new frontier for design in both the digital and real world. If the relationship between a consumer and an artifact is to be maintained and valued, perhaps the level of scrutiny and detail of the surface in a digital environment must be equivalent to that employed by a traditional artisan. Technology has suffered from a lack of intimacy, which an examination of patina in a digital context might begin to rectify. New ways of conceiving of and using digital patina could begin to provide a poetic new language of making across the digital/physical divide.

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