Reconstructing textile heritage

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Abstract

This article recreates a deteriorating archive, bringing life, opportunity and growth to a collection that is in reality dying. It explores a collection owned by the National Trust at Claydon House in Buckinghamshire. Modern techniques of Infinate Focus Microscopy and Computerized Tomography scanning are used to render 3D digital images which are intended to capture the imagination of contemporary artists and designers resulting in an ever evolving archive for future generations. The research identifies that all textile materials have significance and even the smallest fragments may serve as an inspiration to the next generation of creative designers. Focusing on the preservation, restoration and visualization of small insignificant fragments of delicate cloth, the article captures and reinvents the materials, giving a new meaning for future generations.

Keywords

Textile

Fragment

archive

digital

3D scanning

restoration

Introduction

Many leading museums have a wide range of textiles artefacts carefully preserved for future generations to marvel at the intricacy and beauty of the materials. Whilst many collections or part collections are available for public viewing, others are carefully stored in controlled conditions in either museum archives or private collections. Preserving the materials is a painstaking task and requires specialist care which often means that textiles of historical significance are hidden from public view and often only available to researchers under strict conditions of handling. Whilst there is a wealth of materials stored in archives around the globe, there are less significant specimens that are not offered the protection and restoration simply due to cost. These samples are therefore left to deteriorate over time eventually ending life as a pile of dust fragments lost to future generations. According to Kuttruff and Strikland-Oslen: 'Textiles are among the most perishable artefacts, even the smallest textile specimens are of value to understanding production technology and cultural significance' (2002: 354). There is much to be learned about historic textile production to ensure we preserve heritage, but also inspire future generations of artists and designers.

Most textile conservators' main purpose is to stabilize textiles to slow the process of deterioration. However, the role here is different, the aim is to digitally reconstruct the fragments bringing them to a global audience. Digital rendering eliminates the need for the display of the original textile and therefore preserves the fibres from environmental risk and further damage. This research explores whether modern high-tech applications (three-dimensional [3D] visualization) used predominantly in engineering can be employed to capture historic textile fragments to preserve and reconstruct their beauty for future generations. Recreating the material in a digital format brings new life to a dying archive.

Textiles enlighten the senses. Memories and meanings are interwoven within the structure of the cloth. According to Lesley Millar:

> Cloth, in its intimate relationship with our body bears the marks of our being, both on the surface and embedded within the structure. At the same time, cloth is also the membrane through which we establish our sense of ‘becoming’, and formalise our relationship with the external world, while the fabric remorselessly records the evidence of those interactions. (2012: 3)

Unfortunately, not all cloth fragments in archives will exist to tell their tale. In this study fragments rapidly deteriorate due to several factors. Common storage issues such as humidity control and temperature detrimentally affect cloth with the addition of dye and fixing chemicals used to achieve colour. The fragment analysed for this study uses an iron mordant to fix the black colour. This is causing rapid deterioration which will eventually break down the cloth fibres to dust particles and therefore lose the lace structure completely.

This article discusses the methods and techniques which can be used to recreate a decaying archive: a digital archive for preservation and innovation. We are all the keepers of the archive and a digital archive can evolve over time bringing new life to and uses of materials that are currently hidden from view. The archive that is being created will not only capture a moment in time, but also enable digital reconstruction to bring the fragments back to life. Fragments will be recorded as they are at the time of analysis creating an archive specific to that moment in time which will allow details to be digitally reconstructed using exact data and visual references to rebuild the garment in its entirety. Exhibiting textiles in their former glory will be of interest to contemporary designers, costume and textile historians as details such as surface structure, pattern and colour can be examined to inspire new design work.

By capturing images of the textile fragments, digital reconstruction can be implemented so further generations can enjoy a true-to-life image of the textile. This will lead to simulations of textile drape properties through the use of sophisticated algorithms and reconstruction of both historic clothing and the reuse of the images in modern applications. This reinvention of the archive brings it into contemporary design. In order to rewrite the physical textiles digitally, methods must be investigated to capture the properties of the materials, both aesthetically and physically, and which do not destroy the delicate fragments of cloth.

The archive fragment

Textile fragments used for examination in this article are loaned from the English National Trust archives at Claydon House in the Aylesbury Vale, Buckinghamshire. Claydon has been the ancestral home of the Verney family for more than 550 years. The archive at Claydon was fully explored to locate a textile fragment in need of conservation which could not be restored using traditional preservation techniques. The textile pieces are merely fragments, fragile and incomplete. Every year they deteriorate further. The fragment (see Figure 1) dates back to 1625 *c.* and is a linen needlepoint ‘mens reticella’ lace decorative collar. Rows of buttonhole stitches build up the design. It belonged to Edmund Verney who was chief standard bearer to King Charles I during the English Civil War. It is important to note the size of the fragment. It is 10cm at its largest measurement. This meant that handling and positioning was a delicate process (see Figure 1).

The physical archive

Archive textiles samples were scanned using 3D scanning instruments to generate the data needed to render and reconstruct historic textiles. The results of the initial 3D scanning processes informed the exploration and development of imagery. According to Volino and Magnenat-Thalmann: Correction of surname spelling needed

> For a number of years, more actively since the 1980s, the study of digital cloth motion and simulation has been studied by both industry specialists and academia as previous papers have summarized; the complexities in realizing a textile with a high degree of deformation characteristic has been a challenge to researchers since the 1980s. (2000: 3–4)

Relatively few published works exist which look at the possibilities of digital conservation and reconstruction of archive textiles. Current assumed textile simulation data are more often derived for film and gaming communities. Here, animators are required to develop cloth simulations which look appropriate for their own outcome. They are visually flawless rather than historically accurate. In an era of digital advancement, current 3D software packages can often assume the specific range of parameters to portray complex fabric structures, meaning that the 3D simulations are not always realistic. Current software often has a range of assumed fabric properties based on modern-day cloth types, these cloth files are often complete repeats without areas of degradation, rot or dye variability. The latter is needed for archival reconstruction. Analytical methods are necessary with respect to analysing textile fibres. Structural characteristics such as pattern, twist, breakage, angle and yarn count. Methods are discussed and provide examples of the data derived from them. These initial scan techniques aim to look at both the surface structure, yarn and overall 3D structure. The two scanning method used are Optical microscopy and Computerized Tomography (CT) scanning.

Infinite Focus Microscopy (IFM)

The IFM produces a 3D image using two-dimensional (2D) images that have been recorded between the lowest and highest focal plane, areas that are in focus are compiled to produce a repeatable, sharp, true colour image and an accurate reconstruction of the surface of the sample. Surface measurements for the work detailed here were carried out using an Alicona IFM, subsequently referred to here as 'IFM'. Several settings were explored with different exposure times, magnification and contrast were adjusted to gain optimum results on-screen. The results of the scans (see Figures 2 and 3) provide a detailed view of the 3D lace structure. Deterioration of the yarns is clear only by using the IFM not by the naked eye. Measurements of the lace depth are recorded to be used in the reconstruction process. Overall this process gave an accurate visual recording for further study and analysis. The data and file type produced are not suitable for 3D imaging in textile specialist software (see Figure 2).

CT scan

‘X-Ray CT has of course been used for many years to image biological features for medical research’ (Parnas et al. 2005: 1920–35). X-ray imaging fragile textiles requires much experimentation to achieve the desired settings, prior and post scanning process. The instrument used in this study was a Nikon Metrology XTH 225 micro-CT scanner, with a Tungsten X-ray target and Perkin-Elmer detector. Each scan contained 1583 frames which were then reconstructed using Nikon Metrology’s proprietary software. All rendering and subsequent analysis was performed using StudioMax 2.1 and surface determination was optimized manually (see Figures 4 and 5).

The outcome resolution and detail of the CT scans far exceeded expectations. The team doubted whether this tiny fragment, black in colour, would scan at all. Radiation levels used are extremely low in order to limit any damage to the individual yarns. When examining the image data, both in the cross sectional views and in the volume rendering, a certain amount of noise was observed on the surface. This was addressed by adding filters in VG StudioMax 2.1. These filters digitally enhance the image by reducing noise, sharpening the resolution and refining the digital outcome. Filters are subjective as they are manipulated by the operator, however, they only act to sharpen and clean the image, not to redesign. This process generates a highly usable data file type (STL). These visual results are immediate, obvious and also the most compelling in terms of both surface and underlying detail. The textile fragment is captured, almost frozen in time, at the level of deterioration it was when scanning. As the iron mordant continues to destroy the textile fibres, the textile will continuously change until eventually only dust exists.

The image stack and data collected from the CT scan (see Figures 4 and 5) were of such high quality that it could be used in future research for 3D modelling purposes. Constructing not only the 3D visualization but perhaps also a 3D-printed prototype would result in wider accessibility to textile fragments which currently remain only in archives. Most software supports polygon mesh and point cloud data to create, render and animate with no limits on complexity or size. For Wang and Genc: ‘The ability to automatically convert any 3D image dataset into high-quality meshes is becoming the new modus operandi for reverse engineering’ (2012: 5). Tools are rapidly developing, cloth files now generate in real time due to advanced operational hardware power. According to Young et al.: ‘New tools for image-based modeling have been demonstrated, improving the ease of generating meshes for computational mechanics and opening up areas of research that would not be possible otherwise’ (2010: 470). The methodology of converting CT algorithms to generate geometry is an exciting area for future research within the arena of textiles.

Conclusion

This article presents a method to recreate the fragments of textile materials through not only capturing a moment in time, but reinventing it (a new archive is born). It was found that the techniques and processes used, accurately recorded small delicate textile fragments with clarity and detail, giving a new life to the material. The visual data can now be reconstructed to simulate the full textile piece (lace collar) in its entirety. This gives a record of the textile piece in its current state but affords the luxury to reconstruct and reinvent the materials, both historically and contemporaneously, offering a nexus of design and scientific research opportunities. This process will enable a digital archive of items in National Trust smaller collections such as Claydon House to be accessible to both researchers and the general public. By capturing the textiles in such detail it is possible to explore the highly skilled craftsmanship involved in producing a decorative textile from the seventeenth century. The context and history of the yarns begin to tell a tale. As this research progresses it is possible to foresee the contribution:

> Protector of the archive: in order to protect not only the small physical fragments and their handling but also to ensure any reconstruction will be accurate and true.
>
> Creator of the archive: a new archive will be born as the textile fragments are reconstructed to their former glory.
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> Promoter of the archive: digitizing the archive opens the materials up to a wider audience globally.
> Innovator of the archive: new uses of the archive in contemporary applications.

Working alongside a team which includes engineers, conservationists, historians, designers and scientists, this project requires a wide and detailed breadth of knowledge in different and unrelated specialisms, which all collaborate for the purposes of archival conservation. The multidisciplinary nature of the project provides a wealth of networking opportunities and further research opportunities. The future aim of this digital archive is to provide access for a worldwide audience, including visitors to National Trust properties. The framework to be developed as part of this research will provide the underpinning methodology, leading to the creation of a larger digital textile archive for the National Trust, which can be adapted and used by other museums and trust organizations.

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Contributor details

Sophie worked as a commercial textile designer before embarking on a career as a Lecturer of Computer Aided Design in 2010. After much time teaching and experimenting with 3D apparel software she began her Ph.D. study to further develop interests in historical costume alongside cutting edge industrial technology to digitize and render cloth.

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