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Reimagining a 2D Painted Portrait as a Kinetic 3D Sculpture

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Abstract

This paper describes a Cultural Heritage related project concerned with developing computer technology for reimagining a 2D painted still portrait made in a distinctive fine art style as an animated 3D sculpture whilst preserving the principal features of the initial painting yet resulting in an artefact of original quality. This work explores both artistic and technological aspects of a production pipeline. The case-study to prove the concept relies on Francis Bacon's "Study for Portrait (Michel Leiris)". A supplementary video shows the resulting animated piece with Bacon's voice-over.

CCS Concepts

• ***Computing methodologies*** → *Computer graphics;* • ***Applied Computing*** → *Arts and humanities;*

Figure 1: Four animation frames.

1. Introduction

There are two main perspectives to Computer Art. First, as a vehicle to preserve existing traditional art works; to mimic them; or to radically re-imagine them (e.g., using animation). Secondly, it could be viewed as art in its own right, in terms of original artistic forms and content different from traditional ones.

In the Cultural Heritage (CH) context, it is natural to combine both of those perspectives [CMPA18]. Indeed, artefacts based on existing, often classical works, but re-imagined using computer technologies are now considered as belonging to modern CH: they are exhibited in galleries and museums, some of them are becoming a part of permanent public and private collections.

This paper describes one project exploring both artistic and technological aspects of re-imagining a 2D painted still portrait as an animated 3D painting (i.e., sculpture) whilst preserving the principal features of the initial painting yet resulting in an artefact of original quality.

2. Related works

There are many works that have attempted to fully recreate classical pieces in CGI, most being a faithful recreation, with little utility of the kinetic aspects that CGI offers. Some however have utilised the tools that the new medium offers well, using the movement that CGI can offer to bring a new perspective to the piece. Let us illustrate this idea with two representative examples.

Art studio 'Prudence Cuming Associates' had recreated 'Veil of

Figure 2: Close-up from our video featuring 3D sculpture with Bacon's and Seville's strokes.

Faith' by Damien Hirst using photogrammetry to capture the painting fully. They then produced a film to give viewers the feeling of being inside the painting - featuring the camera moving amongst the textured landscape of the painting only to pull out to see the painting as a whole [Hit18]. This use of movement brings a new aspect to the piece that was not previously available without CGI, namely, to witness the heavily textured surface of the painting in micro detail transforms it into an alien landscape.

Another piece that uses the kinetic abilities of CGI to elevate and transform the piece that was recreated is Rob and Nick Carter's "Transforming Vanitas Painting" [Car13]. It is based on "Dead Frog with Flies" by Ambrosius Bosschaert the Younger (1630). The original painting is a still of what the title describes. Carters have created a film that recreated this piece accurately in CGI but included a temporal aspect to the film. They depicted the death and decomposition of the frog with the original composition being only one frame of the film. The introduction of a time dimension works very well in this piece: the frog's transformation flows well into each stage, each frame as well composed and interesting, and the whole work keeps continuity with the original piece whilst also developing on it.

While faithful recreation is not the main subject of this research, the use of those two different aspects of perspective [Hit18] and time [Car13] has been in the heart of it. Applying them by making use of the dynamic nature of CG to a still art piece does result not only in transforming it but also elevating it into something original.

There are several other studies that take on a similar concept of inputting the classical 2D paint stroke into CGI or at least the creation of that stroke using computer processing. However, most of these studies are aimed at the creation of a tool and approach it in a more technical manner on a larger procedural scale rather than the creation singular brush strokes that then form an original 3D piece created within the 3D scape, especially in a dynamic context.

For example, Chen et al [CKIW15] used real time graphics systems to create a painting tool that allows artists to create computer generated paintings that use brush and particle simulations to achieve the visual effect that oil paints create. Wu et al [WCW*18] used generative adversarial network (GAN) to synthesize realistic oil painting brush strokes.

Baxter et al [BLL04] have described a digital tool in an interactive context concentrating on creating impasto within paintings. This tool uses Stokes' equations for viscous flow and a hardware implementation of the Kubelka-Munk equations for accurate colour mixing and compositing of paint. Fluid simulation could be used to simulate a paint stroke and then convert a still of the resulting simulation into geometry of an art piece.

However, we consider those complex techniques as not particularly friendly to artists in the context of our project. In particular, such methods lack the precise and bespoke quality of the brush stroke and limit the forms of stroke that could be created.

Most existing methods and tools allow to produce only flat digital paintings. There are attempts to achieve a realistic 3d effect, e.g., using interactive canvas, accurately registering brush footprints and paint strokes, and integrating interface elements of traditional painting in a digital paint system [VCVL*09]. We have aimed at creating 3D artefacts on the basis of initial 2D paints. Creating the ridges and valleys featured in impasto was considered as paramount. This has required the development of an original method described in the next sections.

3. Artistic References

In artistic terms, replication and layering of brush strokes achieving the 3D effect of impasto [BLL04], has been a long-standing challenge. Another research question was concerned with exploring bespoke quality of painting, namely how each movement produces a unique brush.

Our case-study is based on Francis Bacon's "Study for Portrait (Michel Leiris)" (1978) [Bac78]. The style of the resulting 3D kinetic piece (see supplementary videoclip) is heavily influenced by Bacon's other work, such as 'Three Studies for a Portrait of Henrietta Moraes' (1963). For example, the dry vertical striped brush strokes, evoking a prison like quality, a common theme in his works, were to be reproduced. Bacon's haunting portraits feature the division of the face into primitive overlapping shapes which make the faces move; they become almost uncomfortable to look at as a result. This means his portraits provide a proper basis for kinetic 3D sculptures as having clearly defined shapes that seem to flow into each other.

Jenny Saville, another modern figurative artist, had inspired the thickly applied blocks of flat colour of the piece. "Stare" (2004-5) [Sav05] is one example of Saville's works that illustrates this. The flat colour piece once again should be translated well into a 3D kinetic sculpture as it breaks up the shapes into simpler shapes that can be more easily manipulated during the animation. Saville's works always feature an impressive range of fleshy tones, produced

Figure 3: Production pipeline.

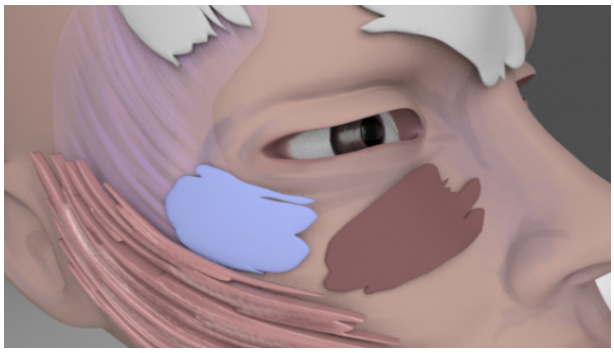

Figure 4: The thick heavily impastoed geometry.

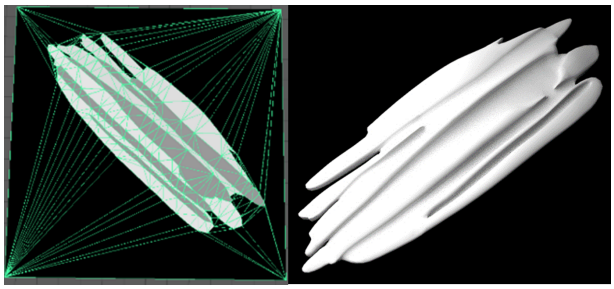

Figure 6: Texture to Geometry tool in Maya (a) and cleaned Geometry (b).

by her studies of raw meat that inspired the colour palette of this piece, especially around the mouth.

Both artists were instrumental in the themes embedded into the artefact, producing something that is uncomfortable to look at that seemingly squirms under your gaze. Fig. 2 shows one close-up from our 3D animation with features similar to the described Bacon's and Saville's ones. The video's soundtrack employs Bacon's own unsettling discussion of his work.

4. Process Overview

In technological terms, our main contribution was to build a methodologically valid production pipeline using modern 'off-the-shelf' software tools, adding some effects the tools lacked (Fig. 3). Let us describe in detail some problematic issues and the solutions that were developed.

After some initial testing it was found that having a base mesh to add layers onto it would work best for animation as the expression could shift more easily and there was a framework for the facial structure. Testing also identified that normal maps in Substance Painter alone would not create the desired texture of paint and that geometry would have to be used alongside normal maps to achieve the appropriate height and texture.

Testing managed to eliminate the unneeded application of ZBrush, streamlining the methodology. This made it possible working entirely in Maya for the creation of the geometry and impasto. A method was identified for creating impasto and texturing to give the oil painted look desired. This included identifying a technique of blending the paint which is something very key to the core behaviour of the paint.

Impasto Alpha creation was completed in Photoshop using Bacon's and Saville's styles as inspiration for each stroke (Fig. 4). Base head modelling was done in Maya, Blendshapes were used for expression changes, and the head turning were key-framed.

Both expressions are based on Bacon's expressions, In addition, the second expression is based on the scene of a woman screaming from the film Battleship Potemkin, 1925, by Sergei Eisenstein (Fig. 5) which inspired Bacon heavily.

Maya's 'Texture to Geometry' function was used to create impasto mesh from the previously made alphas. The Alphas are created with three different tones; the black sections are deleted, and the grey and white represent the differing elevation of the impasto created. These meshes were then cleaned, extruded, re-topologised, mirrored and smoothed to create final mesh (Fig. 6).

Figure 5: Still from Sergei Eisenstein's silent film "Battleship Potemkin", (1925).

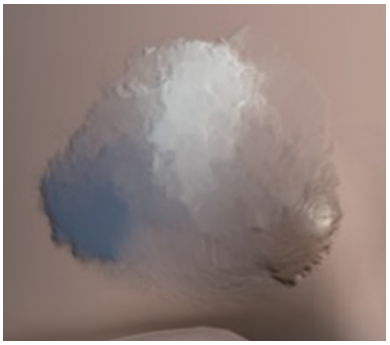

Figure 7: Blending paint using Smudge tool in Substance Painter.

The added mesh strokes were animated using a combination of Blendshapes and simple keyframed animation. This animation had them lengthening and shortening with the movement of the expression. Each stroke was molded to the face, though not flush to create texture and make use of the 3D scape it occupied. The animation for this stage was quite subtle as too much skewed the facial shape and continuity of the face.

Textures were created in Substance Painter using the Smudge tool, painting on a single painted layer for an oil paint quality (Fig. 7). This was done twice as the first result was far too washed out and not nearly impactful enough in tone and shape it created. The palette used was a combination of tones from both Bacon and Saville's works. We also used a fabric texture below the painter layer for height to add the canvas texture underneath the paint.

Arnold was used for rendering, lighting, and depth of field. Finally, the piece was composited and edited using Nuke.

5. Conclusions

This project is concerned with the emerging subject of creating 3D kinetic artworks based on 2D traditional still paintings while preserving and emphasising the features of a particular artistic style. The final artefact (Fig. 1) has a definite painted quality as well as a distinctive unsettling emotional impact. In the CH context, it is expressive as a piece with clear references to the chosen artists in style and theme.

Future work can be directed at increasing the textures quality and making the stoke layering and animation more sophisticated through use of more varied expressions or more impactful movements. The textures themselves could also be animated to add more movement to the piece as a whole.

A more intuitive feel of 3D painting to reach a subtle balance between technical and artistic processes will be beneficial. Creating a bespoke tool for a holistic process where production of geometry and texturing could occur simultaneously will be a challenge. One could explore volumetric representations and the corresponding modelling and texturing techniques (brushes as geometric entities rather than a texture) for further advancing the approach.

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