

Hand-drawn outline experiment with 3D Rendered Images



Abstract

This project is an experimental work to express 2D drawn visuals using both traditional and 3D techniques. It is going to be focused on aesthetic outcome more than technical experimentation. The final product will be a short animation using a traditional oriental style. The outline will be drawn by hand using 3D software as a reference for basic forms. It will be, not only a new project to deliver a successful outcome but also an experiment of a new work flow.

Introduction

Computer graphic technology is forming an ever greater part of the visual media. The quality of computer graphics can achieve closer to perfect reality in the present and for this reason it is an important part of live action film as well. There is no exception in the area of traditional animation as 3D computer graphics are also used for 2D animation industries. It is not a new phenomenon since many 3D tools have been developing towards a 2D style. However, to express the drawn style naturally, traditional hand drawing techniques are still important despite the great improvement of 3D technology.

Therefore, both advantages from 2D and 3D processes should be used in order to produce the best results.

In this project, the oriental painting style of a short animation sequence is presented with traditional hand drawn techniques combined with 3D technology.

Outline of 3D computer graphics

A Chinese style animated show case 'Ode to Summer' in Siggraph 2003 by Ron Hui [1], shows how an oriental style of brush marks and ink effects can be achieved in 3D. The entire scene creates an old Chinese painting atmosphere, where each frame could be perceived as a believable, traditional 2D Chinese painting. It is difficult to distinguish if it is made with 2D or 3D techniques. However when the image moves, it is noticeable that 3D computer graphics have been used.



Fig 1. An example of oriental style animation in 3D, "Ode to Summer" (Siggraph 2003, [1])

(Link) <http://www.youtube.com/watch?v=mSRn6qiZn0c>

The image below demonstrates another short advert that uses this Chinese painting style and has a similar problem [2]. This still image is also shown as a flat 2D image but when moving, the audience senses that it has been done using 3D Computer Graphics.



Fig 2. Oriental style of 3D outline in the TV advert, "Pole Dancing Geisha" (Stash 64.20, [2])

The main reason why the audience can tell 3D software has been used is that the outline is fixed to shape of the 3D model and the outline is also visualised as a solid object rather than a natural fluid drawing.

In Autodesk Maya, when the toon outline tool is activated on a model, the outline is created as a solid object whose shape does not change when the main object moves. In other words, the outline presents a solid object itself as if hard wires are around a statue.

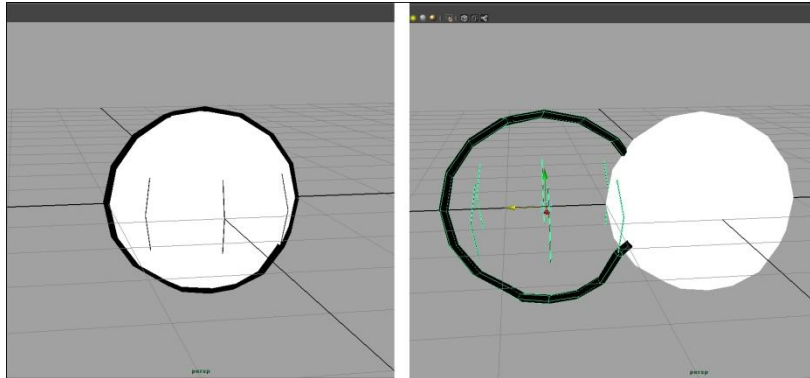


Fig 3. Toon outline tools in Autodesk Maya 2012, [3]

This problem also occurs in Japanese animation industries which have one of the biggest 2D animation markets in the world. For example, in a Japanese TV series animation recently produced, called “Infinite Stratos” [4],[5], there are many battle scenes between people who equip mechanic armour and control it.



*Fig 4. An example of using a 3D toon outline for robot armour and characters
“Infinite stratos”(8-Bit, 2011, [4])*



*Fig 5. The 3D outline of the human character (left) and 2D drawing of human character
(right)
“Infinite stratos”(8-Bit, 2011, [5])*

It costs a lot of time and money to produce pictures of mechanics with traditional 2D techniques, so that the decision of using a 3D outline during dynamic battle scenes is an economic one. For the human characters, 3D CG images are often replaced with hand drawn images at the end of fast motion scenes to match the 2D quality (see Fig 5). However, in spite of their efforts, human characters in particular are still presented to look artificial and solid beside the outlines of mechanic robots.

Another good example of applying both 3D outline techniques and 2D hand drawn techniques is in a famous robot animation “Mobile Suit Gundam Unicorn OVA (Original Video Animation)” [6],[7].



Fig 6. Traditional hand drawn images of a robot
“Mobile Suit Gundam Unicorn” (Sunrise, 2010, [6])

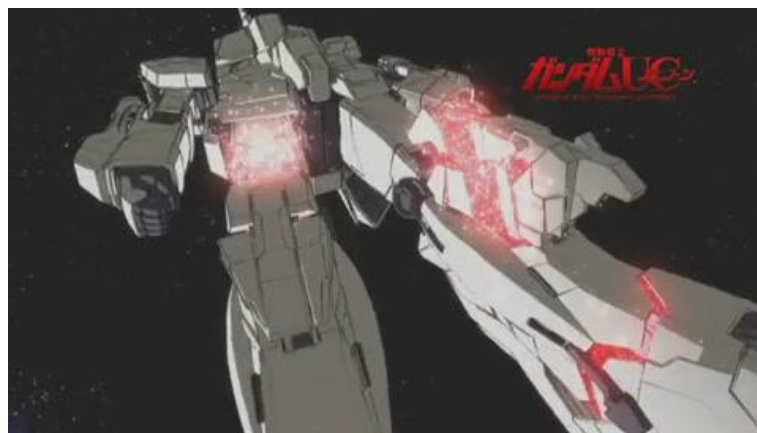


Fig 7. The use of 3D techniques on a robot
“Mobile Suit Gundam Unicorn” (Sunrise, 2010, [7])
(Link, 1:45) http://www.youtube.com/watch?v=hxB_H6iux1w

In this shot since the camera is rotating and the robot is transforming simultaneously, a 3D outline has been used. However this outline does seem natural because it is applied to a hard surface object and the camera does not move enough to present a problem.

Although this 3D outline could have been applied to entire scenes, all the robots in more dynamic shots were drawn by hand. This emphasises the robots more dynamic and organic forms comparing to scenes created by 3D computer graphics.

Therefore, from these examples it is clear that there are special merits for hand drawn techniques over 3D computer graphic techniques.

Hand drawn outline in 2D animations

In that case, traditional hand drawing techniques are going to be the best for the traditional style outline. However, there are equally inherent troubles for 2D hand drawn techniques.

Firstly, animators have to work hard to maintain a consistent shape every time they draw the characters. This problem occurs frequently in episodic TV series animations usually due to tight budgets and deadlines. As a case study, there are examples of such mistakes in drawings from “*Legend of Heavenly Sphere Shurato*” [8], “*Mobile Suit Gundam SEED*” [9].



Fig 8. The difference in drawing quality for the same character between different productions “*Legend of Heavenly Sphere Shurato*” (Tatsunoko Production, 1989, [8])

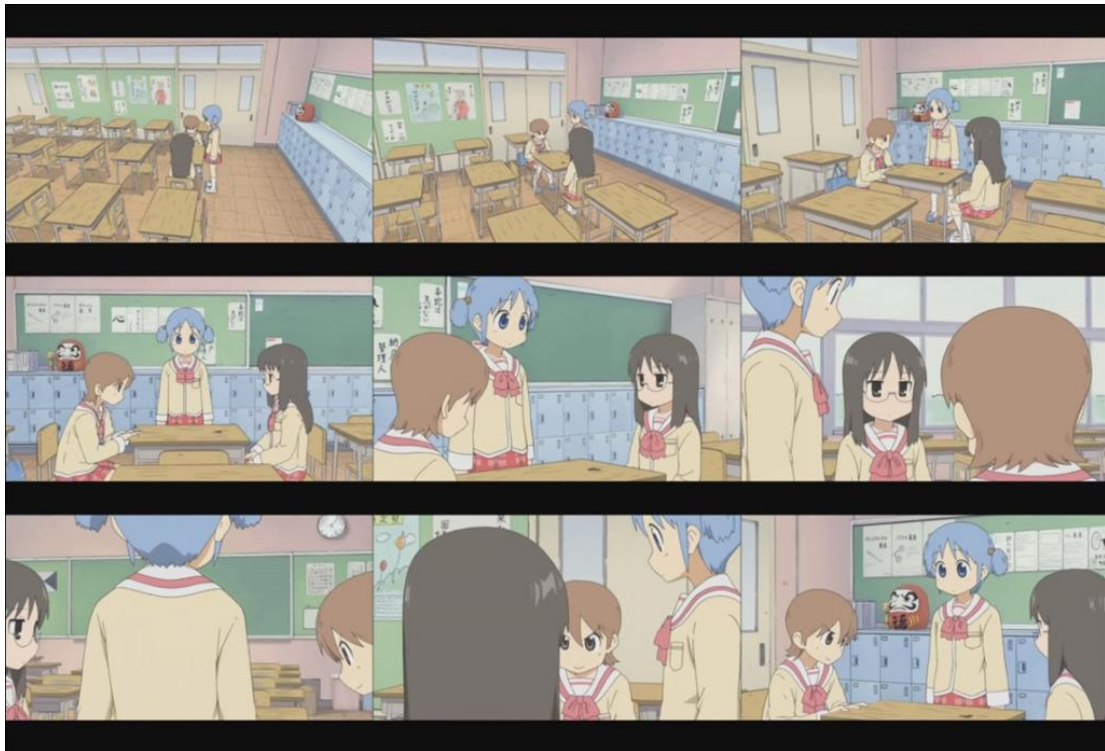


Fig 9. The original TV series (left), Re-master version of DVD (right) “*Mobile Suit Gundam SEED*” (Sunrise, 2003, [9])

These two pictures are supposed to be the same character, but obviously look very different. Commonly they make errors because of difference in the quality of animators, miscommunication between productions, tighter deadlines or ambiguous character design etc.

Second, it is not easy to draw characters during complex camera movement and angles. These days a lot of Japanese animation productions use 3D outlines for complex scenes especially for the background environments.

Another Japanese TV series animation called “Nichijou” [10] uses the 3D toon outline for fast camera rotations. The entire style of the animation is quite simple so the 3D graphic is pulled off more successfully. 3D toon outline images are only used however, in fast camera movement shots. When the shot gets closer to the characters, these are swapped for hand drawn images such as the previous example “Infinite Stratos” [5] (see Fig 5). The audience can still sense that 3D techniques have been used, but it is a good attempt and achieves efficient results.



*Fig 10. The example of 3D toon outline applied in fast shots
“Nichijou (episode 6)”, (Kyoto Animation, 2011, [10])
(Link) <http://www.youtube.com/watch?v=s8-ncTdoqkM>*

If animators had to draw the background and characters at these angles, it surely would cost a lot of time and money. That is why 2D animation productions replace some of the 2D work with 3D computer graphics even if they aim for the perfect result.

Development of the idea

Following this research, it is possible to combine the merits of both 2D hand drawn techniques and 3D CG techniques together.

The main idea of this Innovations project is to set up objects and a camera animation in 3D software and then to draw outlines over the play-blasted images with 2D traditional techniques. It is inspired by roto-scoping animated film and processes of creating internet cartoons.

“Scanner darkly” [11] is made with live action and roto-scoping techniques. This hand drawn outline and painting expresses a natural hand made feel. The live action reference is realistic and therefore so are the drawings, but it creates a unique effect which is different to normal footage. The process of drawing is made easier by live action reference, but this is often seen as a redundant style because it is expensive to shoot live action.



Fig 11. Roto scoping on live action, “Scanner darkly” (Thousand Words, 2006, [11])

Some illustrators acquire great assistance by using 3D techniques. In this case, 3D modelling is used to set up the basic angle and composition for background illustrations and then the illustrator will draw on top. This technique is used in the Korean Web-toon (internet cartoon), called “Song of Cloud” [12].



Fig 12. 3D techniques in Web cartoon,

(Link) <http://comic.naver.com/webtoon/detail.nhn?titleId=63454&seq=1&weekday=mon>

The cartoonist creates Web-toon images using 3D modelling and simulations for the composition and object shapes. Then he retouches the rendered images from 3D modelling for 2D cartoon visualisation. For the repeating process of drawing characters and backgrounds, this technique can be really effective. From following examples and research, this is where I have derived the main concept for my innovations project.

The workflow

The goal of this Innovations project is to create a short oriental-style moving painting. To achieve this, basic composition and camera animation will be set up in 3D space so the main character is just a simple polygon object rather than a detailed model. Then, after setting these up, I will draw outlines over the images manually frame by frame. This plan aims to express the advantages of drawn lines, with believable shapes from combining the strengths of both 2D and 3D.

Design

A form of character design is to be very simple to fit the oriental painting style, so there are no eyebrows and not much detail for hands. In the first illustrations I experimented with, the proportion of the character was shorter and smaller, but this seemed too simple like a child's toy [13].



Fig 13. The original illustrations

For this reason, I amended the proportions to be little more realistic [14]. The background design is simpler than the character; mountains and a temple are drawn by just a few lines of thin brush strokes.

The background is based on old Korean culture and the story behind the piece is that a girl is praying for her wish in front of a nameless flower in a high mountain. The colour is focused on the character and flower to contrast the background.

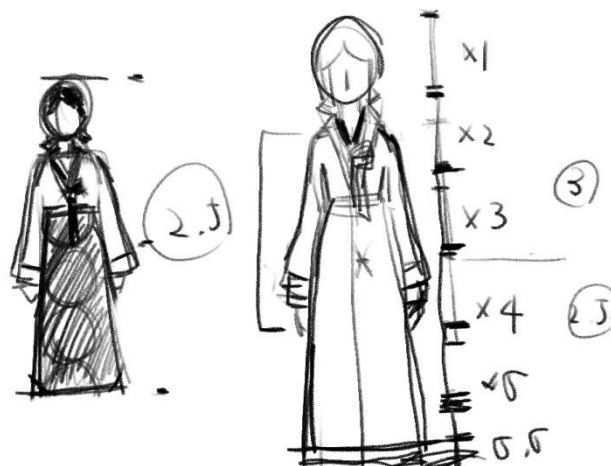


Fig 14. Proportion of the character

Modelling set up

To position the character, simple polygon objects were created just to get the basic shape. Since it only requires this basic shape, the meshes were not smoothed. There are several advantages to doing this.

For one thing it keeps the poly count low which meant I could render images without worrying about the render quality. The other advantage of not smoothing the mesh was that I could concentrate detail into the character's eyes and hands and their positions in space which was really useful reference when it came to the drawing. The red part on the character's chest is a mark for her clothes [15].

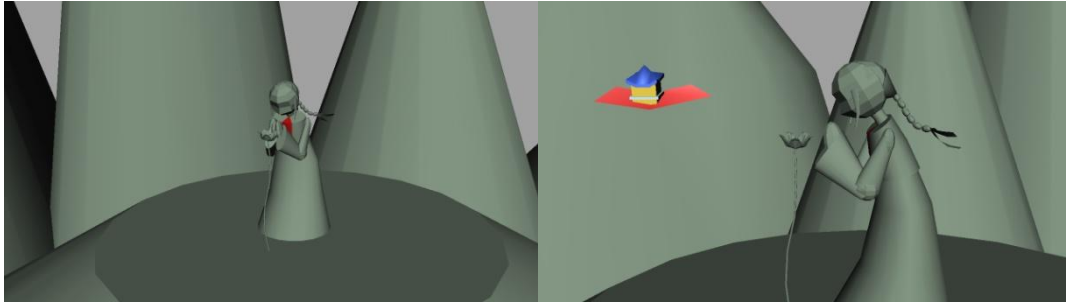


Fig 15. Modelling the character and background environment

I came up with several solutions for the background environment, but the same method was eventually applied to it to keep that expression of extreme angle. The camera rotates around the character and then moves into a close up. It is similar composition to the reference from 'Nichijou (see Fig 10)'.

Drawing outlines in 2D and 3D

Drawing outlines in 2D and 3D After setting up the position of the environment, the images were rendered out using low quality Maya Software render settings. Corel Painter X was then used for the frame by frame, digital hand-drawn layer on top of these rendered images.

The reason I chose to use Painter X was that there are many materials for traditional brush effects. It didn't take a lot of time drawing the outlines using the 3D objects, but the hardest part of the process was drawing outline of the clothes which was not marked on the images. A good advantage of this however is that any small errors from drawing over the perfect shapes produce nice manual effects [16].

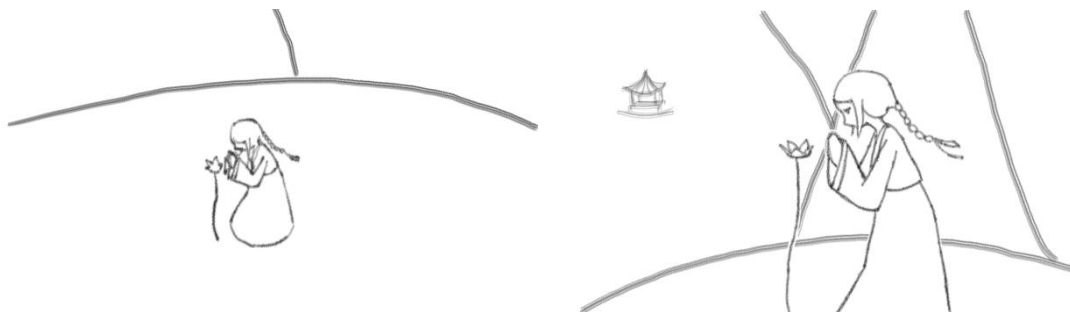


Fig 16. Hand drawn outline of the character and environment

The background environment was drawn after finishing the character outline, so intersecting lines had to be removed when these were merged with the character outline. This did make the process longer.

Shading and Colouring

This was the most difficult problem for to achieve the visual result in this project, because painting every single frame manually is hard and time consuming work. So I chose to render out images of normal surface shaders for this job and then manipulate them as a post-process in Adobe Photoshop. First of all I blurred them so that the range of images edges became smaller and softer. Seeing the blurred shader images under the outlines created an effective transparent effect [17].

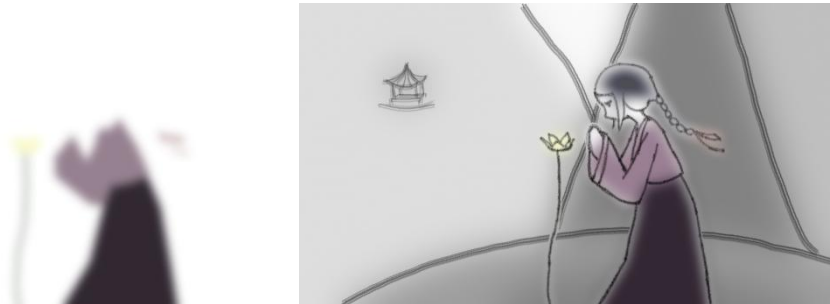


Fig 17. The result of applying colour map with outline

Compositing

There are three main colour paths which are the background colour, the character's colour and the character's silhouette. These paths were then combined with the outline images in Nuke X. The colour saturation increases as it is gets closer to the end. The scale of the background colour map was bit bigger than it should have been which made the character's outline pale. The solution for this was a blue screen technique with white silhouette of characters which helped desperate the conflict between the character and background shade [18].

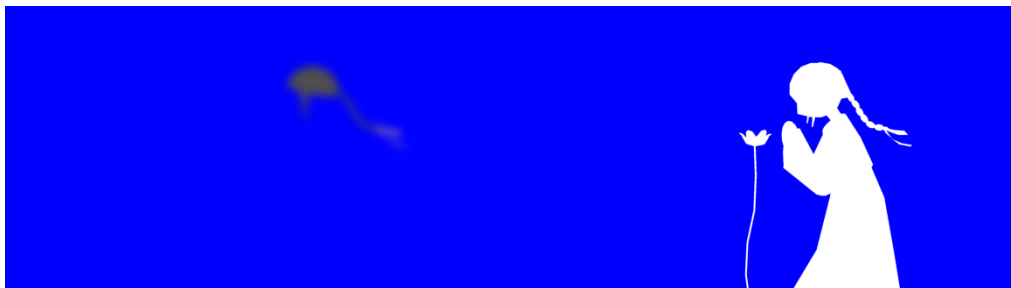


Fig 18. Images from compositing

The colour of character's head was going to be colourised manually in Painter X because the part of head needed more detail and the colour map could be problematic on it. However the result was not very effective considering how much work this process was and the brush mark on the head did not match the look of the other colour shades.

To achieve the feel of an old oriental painting, two old Korean paper texturing images were combined with the outline and colour images [19]. But the background texture was too strong so the visibility of texture around the character was managed by hand in Photoshop [18]. I reduced the frame speed by half by putting each frame twos. This method gives the feeling of limited animation or stop motion effect.

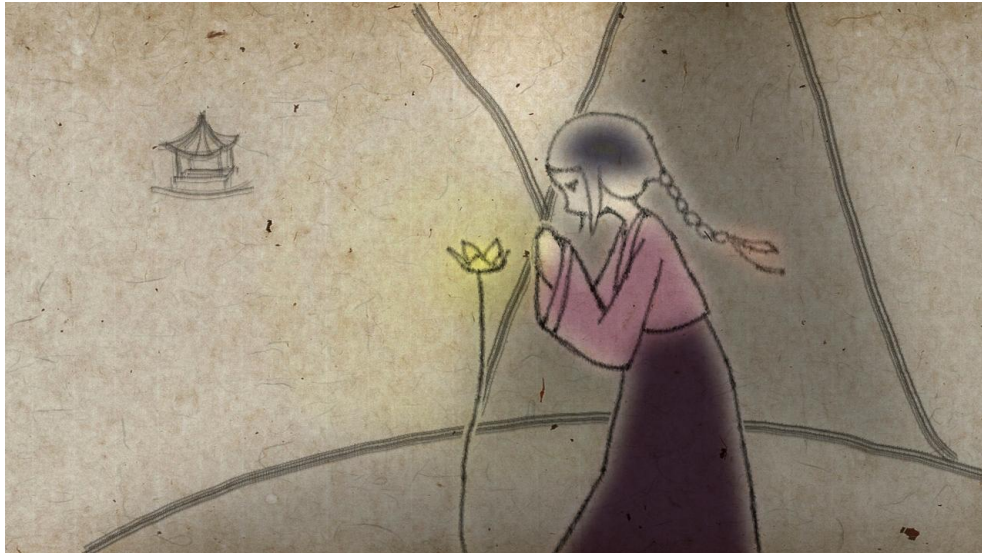


Fig 19. The Final Result

Evaluation and Conclusion

The main challenge of this project was to express a 2D hand drawn effect harnessing the advantages of 3D, so the goal was focused on aesthetic more than technical achievement. The visual outcome reached a higher standard because of the outline, the colour and environment harmonised well and the quality of images are close to the original illustration.

From this result, I did some further investigation into the possibility of using 2D techniques in 3D, but I found it was necessary to have a deeper, more technical understanding of 3D to implement a more effective process.

The problem of the visual outcome is the outline looks little bit ridged because I was copying the position of the object too accurately and this suppressed the fluid manual expression a little. This can be improved however when the outline is drawn more manually rather than copying over the shape of 3D objects. This would be especially more effective when capturing dynamic actions.

Unfortunately the length of this project was too short to achieve more in the time such as exploring moving the character. If there were complex scenes with more characters this could become an extremely slow process.

Lack of 3D technical knowledge was perhaps a bit of a limitation to me expressing a greater variety of effects and slower process too, but most problems were solved by compositing in Nuke.

A flickering outline effect using Mel, Python or shader scripting could be an alternative for these 2D outline effects, but there are still many problems such as needing to change the shapes of lines manually, managing the flickering effect correctly and so on. In the future, I would develop a better tool in 3D which is able to manage outline shapes manually or I would work as a group for faster progress and higher quality.

This outline drawing technique with 3D software was going to be applied to all the images of my Major project, but I am considering whether this might now be too much work for a personal project, so I may only use it for the character's face and certain details with some position marks which I learned from this Innovations project.

Therefore it was a good test for the Major project and it also refreshed my knowledge of Nuke X for compositing as well. This hand drawn outline process is going to be useful to artists who want to achieve a better 2D drawn effect in 3D.

The greatest advantage of this is the cooperation between 2D animators and 3D animators. The quality in 3D software is not necessary, but the basic positions and the fluidity and perfect traditional effects may be achievable faster with this than in the traditional usual ways. The quality of each frame is going to be stable from 3D references, therefore this new method and workflow for 2D animation is something I would like to see considered by the industry.

In conclusion, this Innovation project provided me an opportunity to explore new possibility in computer graphic world as well as an experience of new visualisation.

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- [13] *The original illustrations*
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- [17] *The result of applying colour map with outline*
- [18] *Images for compositing*
- [19] *The Final Result*