

The Art of 3D Sculpted Printing : Royal Coat of Arms Case Study

Design, Development and Prototyping of a Royal Coat of Arms using 3D printing technology
Presented to the HRH the Duke of York, Prince Andrew



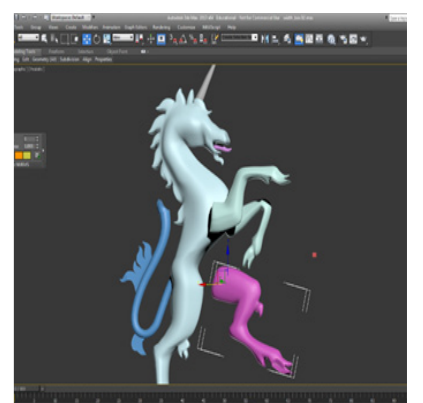
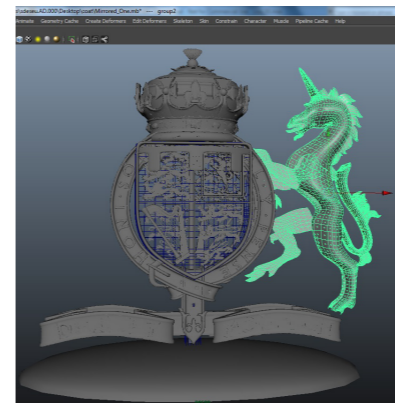
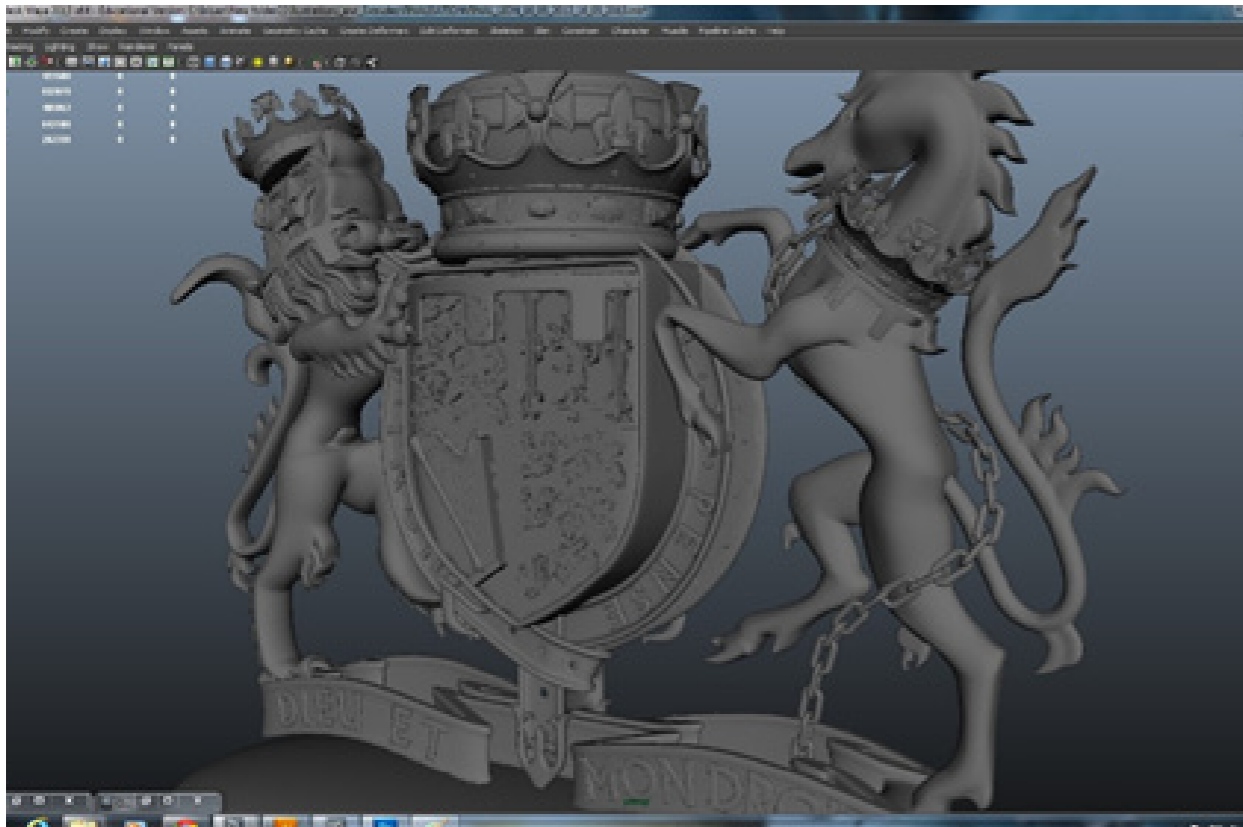
What and Why?

The MA 3D Digital Design team was approached by 3M Buckley Centre to create a 3D printed gift item to then be presented to HRH the Duke of York.

Introduction:

Digital 3D software and the use of 3D modelling is impacting on the evolution and efficiency of productivity and manufacturing across the design industries. 3D printing goes hand-in-hand with 3D software to produce new products by creating rapid prototypes, and enables a faster design cycle, which aids product development. Essentially, it can minimise material waste. The future will be to print what you want when you want from home.

The printing method applied in this research is a relatively new plastic based printing technology and comes at a price. Currently, Formiga P110, the machine used to print out this particular example, cost around £200,000, and stands 6ft tall to 6ft wide. It is not easily camouflaged in your average household. Although there are cheaper alternatives available, they are less accurate and generate a poor surface quality, These alternatives use a different printing and material process which costs around £2,000. (Makerbot Replicator, the Cubify or similar) have the option to build materials at home, but again, the quality is diminished.



Model Development using MAYA & 3DS MAX software:

Before creating the digital model, the designers went through some reference images for each and every part of the Royal Coat of Arms, paying particular attention to the delicate detail on each of the components such as the crowns, lion, unicorn, shield and the text. Most of the parts were modelled based on box polygon modelling and shaped by moving the vertices. Some parts were then worked on in Illustrator and simply extruded to create width in 3DS Max. To maintain a good resolution and flow of mesh, edges were added accordingly, using the Insert edge loop tool and Interactive split polygon tool.

The crown is a simple shape created by using a curve and a "revolve" modifier applied to it. The cross shapes were modelled separately and attached to the curve. The stones and jewels on the rim of the crown were modelled separately and also attached. The anchor, shape which is located in the middle of the shield, was designed using reference 2D images then extruded in 3DS MAX and placed inside the shield. The belt was created by extruding the polygons along a curve in Maya. The text that made up the University logo and the RCOA were created using bevel. The chain was modelled and aligned along a curve so that it looks similar to a realistic rope.

The two main elements of the piece, the Lion and the Unicorn, were modelled using a box primitive then details were added and then blended together. Other shapes were created by soft selection and dragging. The front part of the lion and unicorn were created first and mirrored on to the other side so that it looked uniform and gave depth to both animals. The finished model was then rendered using Mental Ray materials and edited using Photoshop to get some effects.

Renderings:

These are some experimental examples of renderings created using Vray and Mental Ray in 3DSMax. After a number of test renderings materials are applied and animations are created.



3D Prototyping / Production Process

3D printing is a process of making a three-dimensional solid object of virtually any shape from a digital model. 3D printing is achieved using an additive process, where successive layers of material are laid down in different shapes. The STL data from the modelling software is sent to the 3D printer. (Formiga p110 is a product of EOS (Electro Optical Systems) founded by Dr. Hans J. Langer and Dr. Hans Steinbichler in 1989. It uses laser technology which generates three-dimensional solid objects layer-by-layer directly from CAD data. The software first analyses the digital model to check if there are any errors or mesh complications before printing, as the printing process takes a few hours or days to print.

This research has helped to identify the following for a successful 3D print:

- The model should be water tight, by filling the holes if present.
- Check whether the normal are facing in the outward right direction.
- All the parts must be attached into one. There should not be any floating objects without any support.
- The digital model must meet the required dimensions respective to the printer used. It should not exceed the printing dimensions.
- There are minimal wall thicknesses to consider for the material selected.
- Subject the model for an STL check before 3D printing.

Final 3D Print / Prototype

Alumide is the 3D material used to print the Coat of Arms shown below. Although various printing sizes are discussed, the current size is selected for ergonomic reasons. It was designed to hold easily but also see enough details. The only limitation was the machine built volume of 200x250x330mm.

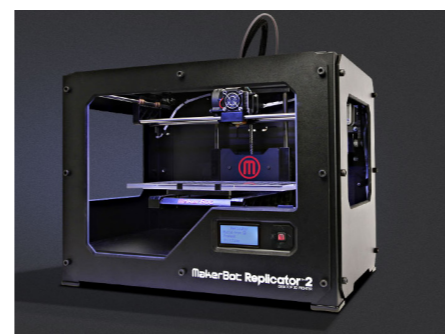


What else can you print / 3D Printable Materials

Fashion & Accessories, Medical Prosthetics, Products, Toys, Architecture, Industrial. There are numerous amounts of 3D printed ability with the room to still grow and discover new things to be printed. There are also a variety of materials used:

- Polyamide: A strong and flexible material with a high level of detail
- Alumide: A polyamide-like material with a distinctive look
- Multicolour: A full colour plaster
- High detail resin: Lovely fine details on this photopolymer
- Paintable resin: Beautiful when painted. Water resistant. If it has to be flawless
- Transparent resin: See through
- ABS: Strong and tough with the highest level of dimensional accuracy
- Titanium: Light and the strongest 3D printing material in the world
- Stainless steel: Not your grandmother's stainless steel
- Silver: Sterling silver
- Gold: 14 carat solid gold
- Prime grey: Very smooth, detailed and "luxurious" to the touch
- Brass: Copper and Zinc, united as one
- Bronze
- Ceramics: A food safe material that shines

Personal 3D Printers



www.makerbot.com



www.cubify.com/



www.cubify.com/



www.solidoodle.com/

What type of 3D Printer system available:

- Personalised: Small size, relatively cheap, limited material options and thickness
- Commercial: Better surface finish, increased material options, larger part sizes improved tolerances but expensive
- Research: Synthetic cells, tissues, high speed micro machines

Comparative analysis of personal 3D printers can be found on http://www.additive3d.com/3dpr_cht.htm. Selection is difficult but as stated in the article on the link above "The best 3D printer or rapid prototyping system is the one that meets more of your criteria than the other"

Conclusion

The whole process was a great learning experience for the design postgraduate students. Creating an object using Polygon modelling tools and to hold it in their hands gave a great sense of excitement about what the future of digital design might bring next. The final result for our first attempt with the EOS printer was satisfactory but not entirely perfect, but only due to the lack of knowledge on how the printer reads the model data given.

With any new clever technology there are always limitations such as print size, currently only useful for relatively small size objects, and the speed it takes to print is very time consuming, especially when the object printed isn't accurate and you have to print again. This was the case with our model, but luckily we had time to correct and print a second one before HRH arrived. Students presented the Coat of Arms to the HRH, the Duke of York Prince Andrew, the Vice Chancellor of the University Bob Cryan, and the Chancellor, Patrick Stewart. They were all amazed at the accurate and intricate detail on the Coat of Arms model and like a lot of people couldn't quite understand how the model was once on the computer to then be printed in plastic and then be able to hold it in your hand.

3D printing has so many benefits and a lot of industries are currently researching and developing how this technology can be used in their services. But 3D models need to be created first using appropriate software. Traditionally, the prototypes are created for fit. The function of an engineering model is therefore created using engineering packages such as Solidworks, Catia, Unigraphics, ProEngineer, etc. Recently, Art and Design packages such as 3D Studio Max and Maya are also employed to create 3D models for physical model making using 3D printing. 3D modelling can be a long and tedious process which last days or even weeks for a designer artist and therefore the model might be costly.

The overall biggest impact of 3D printing so far is on the design industry is bringing ideas to life quickly so that the design development stage can be a lot quicker and accurate, as traditionally model making is done by professionals manually. Working in 3D, designers work directly on a 3D object similar to Clay modellers using MudBox or ZBrush software for additional artistic details, designer can see the result immediately and if necessary undo which is not possible in traditional model making process. Also checking all dimensions and sizes in 3D is a major advantage compare to 2D or manual process. However, 3D printing systems are still a long way off becoming a household necessity due to price and size. But, as we have all witnessed with the evolution of any technology, one day we may be able to fit a 3D printer into our back pockets.



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