SHAPING THE FUTURE OF SHAPE

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ABSTRACT
This paper is a continuation from papers presented at previous PDE, EPDE and SEED Conferences. The paper will outline research being developed by the Creative Design Research Group, in the School of Design, Engineering & Computing at Bournemouth University. The main aim of this paper is to describe research into shape and form, the translation technologies and how it can support the education of design students with aesthetic design decisions and applications. The research is a development from previous research into a design tool for colour semiotics. The paper discusses a research project at the inception stage; the assessment of the beauty of form, shape and sculpture by the study of symmetry and the golden ratio in 3D objects. The paper will make reference to product and engineering design and the potential integration and application of this research for the education of the designer of the future.

Keywords: Design, creative, aesthetics, semiotics, beauty, shape, form, proportion, golden ratio, symmetry, translation technology, rapid prototyping

1 INTRODUCTION

The commercial aspect of design in society has developed to the point where an automobile may be considered a fashion accessory. The desire for product image and style places aesthetics as essential criteria for an increasingly more demanding and discerning commercial world. The designer is being challenged to develop aesthetic styles for more varied and specific markets.

Design languages are constructed by companies shipping larger portfolios of products to create specific identities in sometimes crowded markets. Visual and interactive languages can span wide and varied demographics in different cultures. Embracing both hardware and software the aim is to create a complete story, including form, colour, material, finish (CMF) and user interface. In doing this it is possible to address specific user groups, allowing the user to form a bond with a product that connects with them on conscious and sub-conscious levels. More defined, extreme languages and design stories behind products make for a stronger character, leading to design icons. It is also possible to change a product look fairly significantly by modifying CMF. This particular point becomes more apparent when designing platforms of products that use one aesthetic, but are released under several different guises [1].

An understanding of design form within the context of design language is an essential part of the design student experience. The rest of the paper will consider the key areas of: Aesthetics and Semiotics; Design Form and Translation Technologies, key areas in shaping the future of shape in design education.

2 AESTHETICS AND SEMIOTICS

Aesthetics in design falls into distinct but related categories: Beauty and perfection; character and expression. These can be applied to distinct and integrated design media: Colour and texture; shape and form. The analysis and synthesis of aesthetic design lends itself to the field of Semiotics. The underlying design message portrayed through the composition of design media, has direct correlations to semiotics theory. These include the signifier-signified relationship (Saussure); object-sign-interpretant association (Peirce); denotation and connotation (Barthes); exchange and comparison (Levi-Strauss); convention (Lacan); difference (Derrida); syntactics, semantics and pragmatics (Morris) and the aesthetic function (Mukarovsky) [2].

Icons are the most expressive form of a design language or concept. Depending on the product or market icons define a specific look and feel, trailblazing a design direction. Other products follow these strong design statements, these propositions share the design language DNA, but still have their own specific character providing differentiation. Icons can be released at any position in the market (low end or high end). Work is generally undertaken to understand how a language is translated at different ends of a budget, to ensure it is not diluted or changed enough to become something else. Extensive planning precedes any design language or icon development, design groups need to be clear as to where to position a look or specific design and why. At a higher level, studies are undertaken assessing trends and cultural directions helping to define design directions. External inputs are fused with internal viewpoints as to where the design should be forming a language icon [1].

Design students need to be able to identify and define aesthetic character and expression through design language and translate this definition into the design form.

3 A COLOUR SEMIOTICS DESIGN TOOL

The structuring of aesthetic design media is exemplified in the field of colour, in the development of the Colour Image Scale by the Nippon Colour & Design Research Institute [3]. The research developed and produced semiotic associations between colour combinations and descriptive fashion adjectives (e.g. romantic, chic, pretty).

Previous research into colour semiotics at Bournemouth University has resulted in the development of a design tool to propose colour concepts for products [4]. The tool works with natural language descriptors and colours and forms semiotic associations through AI inference engines, based upon a many-to-many relationship as a semantic net. The tool can generate colours from words or words from colours, that are value weighted and proportioned through a fuzzy logic, rule-based production system [5]. The research has the potential to develop further to include other aesthetic media such as shape, form and design language [6].

The application of AI illustrates the future potential of computer systems to assist in the composition and subsequent education of design form and language.

4 DESIGN FORM

Luigi Colani states "The Bauhaus got it absolutely wrong. Form does not follow function. Form follows emotion!" He goes on to state that his best projects are those that represent "Ninety percent nature and ten percent Colani as the translator." [7]. But what method can be used to develop present design students to understand the beauty of 3D form and translate this into attractive products?

This research is related to the analysis and assessment of 'beauty' in 3D form to produce an object, based upon symmetry and the Golden Ratio. The structural parameters that will be assessed are proportion and developed by their relationship to one another. Initially the controlling proportion will be the irrational number Phi – commonly referred to as the Golden Ratio. Huntley [8] claims that the Golden Ratio has been considered as the key to mathematical beauty since the time of Pythagoras. Hence the Golden Ratio, and its expansion into three dimensions, will be used in the assessment of new consumer products, such as the iPod and mobile phones.

The Golden Ratio is known by a number of different names, such as the Golden Rectangle, Golden Section, Golden Mean, Golden Number and the Greek Letter Phi. The ratio has a numerical approximation of 1.618033989 to 1. To develop this the following ratio can be used: **1 : 0.618 : 0.382 : 0.236 : 0.146**.
The Golden Ratio appears in many geometrical constructions. For example, it appears as the ratio of a side to base in the 72; 72; 36 degrees isosceles triangle that can then be developed into the only mathematically generated golden section in a 3D form; *a pyramid.*

When assessing products in two dimensions the ratio of 1.618 to 1 is used, but what ratio should be used for the third dimension to achieve symmetry and 'beauty'?
From measurement of a range of Apple consumer products [9]:
The fifth generation iPod's measurements are: 103.5 x 61.8 x 11.0 mm.
The iPhone's measurements are: 115.0 x 61.0 x11.6 mm
The iPod Nano measurements are: 90 x 40x 6 mm [Authors measurements]
By reviewing this in the two dimensions of the working face the ratios are:

5th g iPod ratio: 1.67 to 1.	iPhone ratio: 1.88 to 1.
iPod Nano ratio: 2.25 to 1.	Golden Ratio:1.62 to 1.

It can be noted that the iPhone has a black section and a silver section and by reviewing the silver section only then the ratio is 1.56 to 1. Is this a clever use of coloured sections? What can be used to assess these products in three dimensions to achieve an evaluation of the 'beauty' of the 3D profile? If the third figure in the Golden Ratio of 0.382 is taken then should a 3D object be of the ratio: 1 : 0.618 : 0.382.
Whereas the 3D products are:

5th g iPod ratio: 1 : 0.59 : 0.17	iPhone ratio: 1 : 0.53 : 0.19
iPod Nano ratio: 1 : 0.44 : 0.15	Golden Ratio:1 : 0.62 : 0.38

Is it relevant that the third dimension is only one of the series of the ratio? Or is it relative at all? The key issue lies in the formulation of a theoretical model for the beauty of proportional form of a 3D object.

Detailed form studies are performed on all products. Different tiers of product can be visually segmented via using different forms, aspect ratios and colour breaks. Perceived thickness and overall product size is important within mobile product groups such as telecommunications, cameras and portable music players. These areas can be addressed by splitting products with colour, materials and textures. Carefully planned positions of colour splits allows for a designer to make a product appear smaller and thinner than it actually is. Areas of products are enhanced improving the overall experience, appealing to the consumer. Screens are made to look larger, keypads bigger and perceived higher quality. Tactile cues are added to make the product more intuitive appealing to conscious and subconscious values of the consumer. Areas of interaction look as if they can be touched, places that emit sound look as if they perform the function. In getting these details right a designer creates a device that can be used, understood quickly and fulfil all needs. This whole exercise is to present the consumer with an optimised experience, a product which appeals to specific values [1].

The future of shape in design education must build upon the two key areas of Character and Beauty, essential criteria for the development of expression and perfection in the creation of design form.

5 TRANSLATION OF SHAPES

5.1 Innovative Translations

Today, an unprecedented number of parts that contain smooth-flowing shapes are created to satisfy modern-day styling requirements. Products that have many complex surfaces are difficult or impossible to communicate using traditional 2D drawings or 3D rendering. Furthermore, during the development of some products (e.g. handheld devices) designers need to be able to find out what a physical object will feel like in order to prevent some of the barriers encountered in design [10]. At Bournemouth University, product and engineering design students learn different ways to produce and communicate physical models that have many complex surfaces. By using state of the art rapid prototyping and manufacture technologies, combined with reverse engineering, the students are able to produce their ideas accurately together with the right shapes, textures and colours.

5.2 Methodology

This section describes the process used to convert a blue foam model to a polymer part with the desired shape and colour. This process was developed during a previous research project [11]. The blue foam model of a cover (see Figure 1a) was scanned on a rotating table (4 scans at 90 degrees) with a Konica-Minolta 3D scanner (Vivid 900). The point cloud captured by the scanner was processed by the software Rapidform from INUS Technologies. This processing merges the four scans and reduces the point cloud to 138,000 points with an accuracy of 0.02mm. This creates a series of polygons and consequently four shell meshes. The shells were merged (see Figure 1b). An auto-surfacing option was used to map a number of NURBS surfaces onto the final shell. The surface model was then exported as an IGES file to the CAD software: SolidWorks. The optimised 3D model of the cover (see Figure 1c) was finally exported to an STL file: the standard input for most rapid prototyping machines.

The rapid prototyping system selected for this work is based on the Fused Deposition Modelling technology (FDM) from Stratasys. The STL file was transferred to the Insight pre-processing software. Using this software the 3D model was orientated vertically to improve the accuracy of the built pattern. The model was then horizontally sliced into more than 600 thin sections (0.125mm). The FDM process was selected for its excellent stability, good features definition and its innovative water soluble support material. The part was submerged in an ultrasonic bath of water-based solution for three hours at 65ºC. The supports were then dissolved leaving the cover model clean and preserving any fragile features (e.g. the snap fit). The FDM of the cover had a surface texture applied and is shown in Figure 1d.

To make the silicone rubber mould the pattern was suspended in a box. A casting gate and 18 venting rods were attached to the pattern before pouring de-gassed silicone rubber into the box. After further de-gassing in a vacuum chamber the mould was removed and placed in an oven to cure. When fully cured and removed from the box, the silicone rubber was then cut following a visible parting line marked previously on the edge of the pattern. The mould was then reassembled (without the pattern) and taped together ready for casting. For the cover a polyurethane resin was mixed under vacuum together with some colour dies before being injected into the mould. After curing the resin in the oven the cast prototype was removed from the mould. The casting gate and runners were trimmed off. The cast cover was an exact reproduction of the pattern model.

5.3 Limitations

Time, cost and feature definition are the main drawbacks of the technologies used with this process. However hardware and software providers are currently investing a lot of resources to enhance these technologies [12]. Improvements will seek to increase the accuracy of the scanned data and enhance the feature definition of FDM alongside decreasing the built time. The SLA system is an obvious route for enhancing the surface definition of the rapid prototyped pattern.

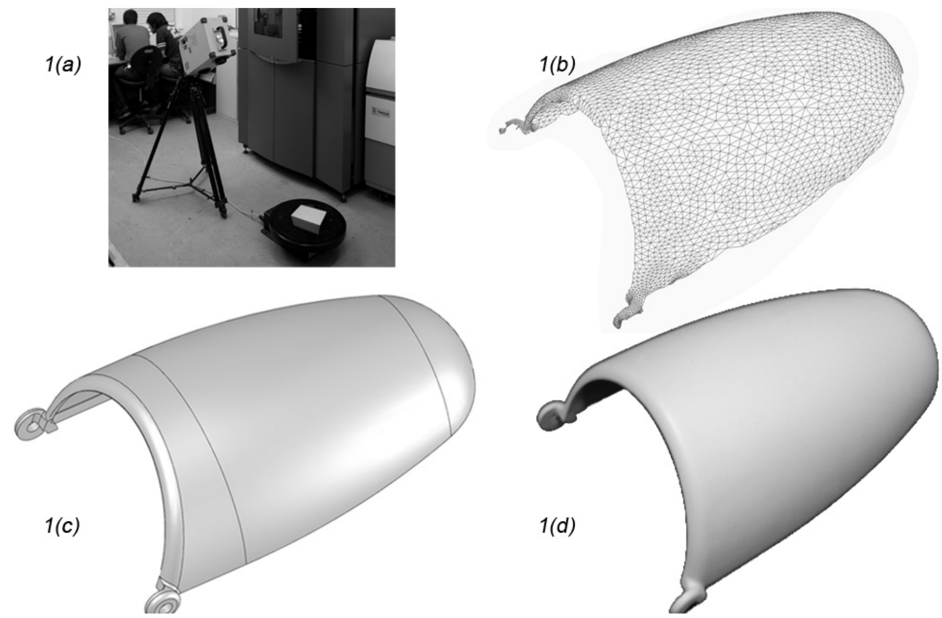

Figure 1 The process from a blue foam model to an ABS pattern

The application of translation technologies is an essential part of the design process for the realisation of the actual 3D form, throughout and at the end of the design process.

6 SUMMARY AND CONCLUSION

Given the broadening commercial dimension of design futures and subsequent depth of consideration of aesthetics; it is essential that the education of designers considers in depth and detail the integration of new creative methods for shape and form into the design process.

To capitalise on the capability of rapid manufacture to produce any shape, designers will need to think in new ways, with more imagination, increased creativity and 'direct' customer input. This is a key element in the education of future designers: in the definition of the design character and expression; the detailed perfection of the form; on to the iterative translation of the form through to the final design.

This applies from the initial design language through design tools and translation technologies, to a finessed and detailed design form icon. This gives rise to the potential emergence of new design practise and its education for future product and engineering designers in shaping the future of shape.

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