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The virtual environment in design projects

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Abstract

Traditionally design projects for students have been based around conventional sketching methods, soft models and marker renderings. As we enter the 'Information Age', it is important that designers are taught to address the challenges that technology brings and also to utilise its benefits in the product development process.

In this paper we report on:

A) Systems-based Design projects tackling Information Ergonomics and Graphical User Interfaces – We present case accounts which indicate the potential of interactive screens. We report that these provide a realistic Graphic User Interface for a product so that proper Information Ergonomic analysis can take place. The main attraction of the Systems Design approach is that it allows students to gain an insight into the ways in which products interact with one another and with the user.

B) The use of virtual and actual 3D CAD models as a way of presenting a traditional Industrial/Product design project. – We consider the advantages that the latest CAD modelling techniques can enjoy over traditional model-making and how the two can be used in sympathy. (Supported by case account)

Keywords: CAD/CAM, computer-supported design, design methods, information ergonomics, design education

Introduction

Many would argue that the 'Apple Macintosh' has eroded the skills base of those engaged in the field of Graphic Design. A casual observer of the appointments pages will have noticed that advertisements for Graphic Designer have gradually been replaced by Graphic Designer/Mac operator. As a profession, Graphic Design has been quick to meet the threat and move itself onwards, embracing multi-media (tightening their embrace on the 'Mac') and acquiring new skills.

In our own field of Industrial/Product design, solid and surface modelling software programs such as I-DEAS Master Series and Pro-Engineer could deplete the usefulness of traditional Industrial/Product Design skills such as rendering, model making and even technical drawing. However, if this challenge is addressed, design graduates can be equipped to maximise the benefits of both traditional and computer-based disciplines.

Overview

In this paper, we explore how best to educate designers so that they can respond to this challenge and be comfortable with a development process that is a marriage between technology-led design and traditional skills. There are a number of advantages that traditional techniques enjoy over the CAD model. Amongst these are the ability to appreciate scale, the resolution of detail, the sensation of touch and of weight and the sheer convincing reality. However, there are significant advantages in using computers as a design tool: alterations to colour, scale, overall finish and graphics can be made easily, as can detail changes to mouldings and structures. Data can be produced which will indicate the likely success or otherwise of components as production parts and how they will perform under stress.

CAD can be used as a powerful design tool, to simulate both form and function in a virtual

environment. This information can be easily modified to generate a number of iterations. The increased level of information available then aids the process of convergence, to a final solution. The final design solution can then be performance-tested for both form and function.

Our Response

We are currently utilising two approaches to address the developments indicated above:

- the use of Systems-based Design projects utilising Graphical User Interfaces;
- the use of solid modelling CAD to produce virtual models, replacing or complementing traditional workshop-based model making techniques.

A further development of these approaches is currently being researched and will filter through to the curriculum in the near future. This utilises a combination of CAD models and Graphical User Interfaces to create 'Virtual Prototypes.'

Section A

Systems-based Projects

One of the features of UWIC's BA (Hons) Industrial Design degree is the two major projects undertaken in the final year, the first is based, not on a single product, but on a system of products.

The work that the students produce falls into three main categories:

- products interacting at consumer level to create a system (e.g. 'Lego' bricks),
- products interacting at national or international level to create a system (e.g. inner-city transport),
- products interacting with computer software to create a system (e.g. an electronic passport).

Inevitably, a high percentage of projects tend to look at hardware/software interaction and this in turn often means that the traditional Industrial/Product design activities tend to be displaced in favour of Graphical User Interface

design based on Information Ergonomics.

When the Systems project was first introduced, the results of students' endeavours tended to be displayed using pages of paper with screen images, flow charts etc. Not surprisingly, this lacked the impact of the real product. More recently, students have begun to use software such as 'Corel Draw', 'Macromedia Director' and 'Dazzler' to produce more realistic results.

In recent projects, the use of touch screens has enabled students to further blur the line between real and virtual product design. Our students can now design a product (system or otherwise) and produce an on-screen visualisation. The combination of software animation techniques and touch screen technology makes it possible to create virtual products in an undergraduate environment. Users can then interact with these prototypes in much the same way as with the real product. In this way we are able to view, with far greater clarity, the quality of work that the student has undertaken. Likewise the student is able to "test" the product much more effectively and deliver a design of greater depth and subtlety than before. Information Ergonomics issues can be explored, using the multi-media model, far more effectively than by using the old display chart method. Sound can be added-for example, so that a switch will make a satisfactory click when it is activated, to reassure the user that the operation is completed.

Sound gives the designer another tool with which to influence the user's interactive experience. As well as the traditional mechanical noises mentioned above, there are a number of software sounds which have universal meaning: alarms, fault warning notes, correct answer-tones etc have become common currency, bridging barriers of language, race and culture. There are also universally accepted visual cues which are used most effectively in multimedia applications. Industrial/Product design graduates who are conversant with these languages will have a better chance of success in an increasingly competitive sector of the job market.

Case accounts

Three case accounts of recent student work follow, which illustrate the issues indicated in the previous section. As each group of students addresses this type of design project we learn a little more and discover ways to improve this type of project.

1 A Navigation System (The halfway method)

A good example of a systems project using this new media is a navigational aid for pilots of large ships. The student in question had identified that there were a number of flaws with existing navigational aids and had been able to point to a number of maritime disasters which highlighted the scale of the problem.

This particular example is a good case of a student opting to make a display which is not fully interactive. The object of the exercise is to display design prowess rather than computer programming skills. Time spent designing the complex mechanics of user interaction is likely to be at the expense of proper examination of the design of the Graphic User Interface itself. For this reason we encourage the use of a less interactive computer model in cases where the complexity of the system would distract from the core activities of the project.

This student elected to use the computer as a tool to explain the system more fully and more satisfactorily than can be achieved by the use of more traditional display methods. The viewer is invited to press the start button and the display commences. A number of pre-programmed scenarios using sound, light, colour, movement, numerical and graphical data are displayed. Various features are displayed in a pre-determined order ensuring the viewer leaves with a full impression of the system's capabilities. Experience has shown that it is far easier to convince visitors of a given system's viability by this method when it appears to "work" before their eyes rather than asking for a leap of imagination from flow chart and story board information to interactive product.

2 In-store Guide (The interactive model)

In contrast to the case above, the work of this student shows what can be achieved when a more modest system is undertaken. In this example the student has identified a problem with information management in large department stores. Large stores tend to employ staff with knowledge of specific services within the overall shop (e.g. the butchers, film processing labs, delicatessen). When shoppers are unable to locate specific products within the store, which often happens, then these specialised staff are unable to help and the customer is forced to look elsewhere for an answer to their query.

The concept for her system was therefore simple: design a user-friendly in-store information guide which helps customers find products when the right staff cannot be located.

In this model the software "product" is interactive, and with the use of a touch screen an extremely realistic analysis of the Graphic User Interface's usefulness can be undertaken.

It is interesting to note that, unlike the previous example which was designed using Corel Draw & Macromedia Director, this project was implemented using 'Dazzler' - a shareware package that the student received taped to the front of a magazine.

Section B

Spectacles Design

A study of the impact of CAD and Rapid Prototyping on design realisation.

The 1st year students of both the BA Industrial Design & BSc Product Design & Manufacture degrees at UWIC annually participate in a live project with Norville Optics Ltd, Gloucester. The best results of this collaboration are submitted to a national design competition run by the Worshipful Company of Spectacle Makers.

As part of the project, Norville help with the construction of prototype frames for those

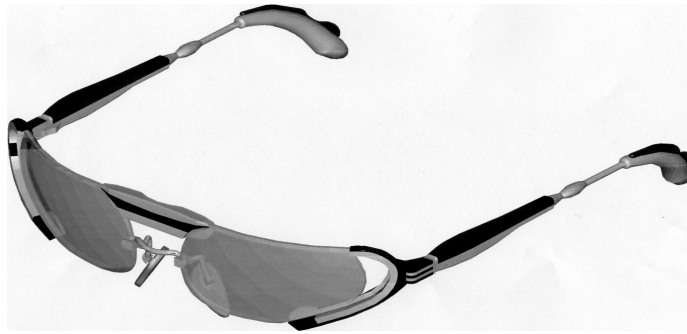


Figure 1 Spectacle frame

students whose designs are within the scope of their manufacturing capabilities. Those students who have produced designs outside the scope of Norville's facilities are obliged to build their prototypes by hand, in our modelmaking workshops and in their spare time.

This case account is an excellent illustration of CAD and Rapid Prototyping supplementing traditional model making facilities. (Figure 1)

The problem this particular student encountered was that his design was complex. Technical drawings highlighted an almost complete absence of reference points or even straight lines. When he attempted to make the frames in our workshop he found the task beyond his skills and our facilities. The student had then to look for alternative ways to make his spectacle frames.

I-DEAS allows complex free form shapes to be modelled relatively easily and as with any CAD system, it can create mirror images of components so that only half of any symmetrical model need be built. This particular model took around two weeks to complete. At this point it was given to the Design Engineering Research Centre (DERC) who used the data to manufacture the frame components using their Stereo Lithography facility. (The DERC is part of the Faculty, which also includes the school of PDE. They are equipped with both Stereo Lithography and Laminated Object Manufacture facilities and students are able to have access to these facilities, by arrangement, for more advanced projects). The completed components were returned to the student who went back to the model making workshop to finish, colour and assemble them using traditional techniques.

Rapid Prototyping is still a relatively rare process in the area of undergraduate projects. However, we feel that it is important to engage in a small number of case study projects for use as examples of new practice in more generic manufacturing process or model making courses.

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