

# The Virtual Environment in Design Projects

By: James Fathers & Steve Gill

School of Product and Engineering Design

University of Wales Institute Cardiff.

Keywords

CAD/CAM

Computer-supported design

Design methods

Information Ergonomics

Design Education

## **The Virtual Environment in Design Projects.**

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 matters such as Graphical User Interfaces, the design of controls for technology based products .

In this paper we report on:

- A) Systems-based design projects where matters of Information Ergonomics and GUI's are addressed.
- B) The use of 3D CAD models as a way of presenting a final design project.
- C) True virtual prototyping and evaluation. This area is currently in the research stage where a 3D CAD model of a product is tested for usability exclusively in the virtual environment.

**Key words :** CAD/ CAM, Computer supported Design, Design methods, Information Ergonomics, Design education

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### **Introduction**

Many would argue that the 'Apple Mackintosh' 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 A casual observer of the appointments pages will have noticed that advertisements for Graphic Designer have gradually been replaced by Graphic Designer/Mac operator.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 modeling software programmes 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:**

There are two models that we are currently utilising to address the issues discussed above:

- Computer based Systems Design projects utilising Graphical User Interfaces
- Using solid modeling CAD to produce virtual models, replacing or complementing traditional workshop-based model making techniques.

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

## **Section A**

### **Systems based Projects**

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

The work that the students produce fall 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 student's 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 have enabled students to further blur the line between real & virtual product design. Our students can now design a product (system or otherwise) & produce an on-screen visualisation. The combination of software animation techniques and touch screen technology make it possible to create virtual products in an undergraduate environment. Users can then interact with these prototypes in much the same way as 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 & subtlety than before. Information Ergonomics issues can be explored using the multi-media model, far more effectively than 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 studies**

Below are three case studies of recent student work which illustrate the issues discussed in the previous section. As each group of students address 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 explained using this new media is a navigational aide for pilots of large ships. The student in question had identified through research that there were a number of flaws with existing navigational aides 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 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 systems capabilities. Experience has shown that it is far easier to convince visitors of a given systems 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 model 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 etc.) 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 can't 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 years 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 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 study is an excellent illustration of CAD and Rapid Prototyping supplementing traditional model making facilities.

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 like any CAD system it can create mirror images of components so 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 completed components were returned to the student who went back to the model making workshop to finish, colour & 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.

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.

## **Section C**

### **Future Developments**

#### **Combining CAD models and GUI's**

The next step in the evolution of the virtual design must be to combine CAD models and computerised Graphic User Interfaces.

Packages such as 'Macromedia Director' & 'Corel Draw' can be made to work with I-DEAS to produce virtual models that provide interaction at a realistic level. In this way we will be able to create products, which can be viewed from any angle, weighed, analysed for stress and optimised for production..

Assessments will be possible on the structure, best finishes and so on. In addition we will be able to assess the user interaction on an entirely new level.

#### **Prototyping in the virtual environment.**

In recent years a new prototyping technique has emerged which uses interactive computer simulations of products to test the usability of new designs with the intended users. This enables prototypes of interactive products to be produced quickly, and then used to evaluate the product without the need for expensive proprietary hardware. However, there are concerns that these virtual prototypes do not accurately represent the final product.

If a highly interactive prototype is required and the product's mechanical functions (e.g. doors opening/closing, sliders etc.) are not too complex, then a virtual simulation of the product maybe appropriate (Sharp et al., 1996). The benefits of using virtual simulation prototypes are usually associated with greater flexibility for making modifications, quicker construction times and reduced development costs (Cambridge Consultants Limited, 1997: Emultek, 1997b). Until recently there was a lack of rigorous empirical work to support many of the current ideas on integrating virtual prototypes into successful new product development. Sharp has however conducted controlled user trials which address these areas of concern. The study consisted

of a domestic electronic product and a virtual simulation of the same, with which interaction was conducted via a touch screen. The subjects were asked to attempt a number of tasks on both the virtual and the real products. Their responses were logged and comparisons were made. The main conclusion was that for this type of product there was little or no difference in user response between a virtual and a real prototype. We will be reporting this work in another forum. (Sharp et al., Ph.D. Thesis 1997 & Private Communication).

We intend that this new work on virtual prototyping will influence curriculum development on our design courses in the near future. Students will need to be conversant with the methods of product development that are being used in leading companies, and be competent in the application of the appropriate blend of traditional and technology based skills for each design problem.

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(Word Count 2365)