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Computer models, handmade in Europe

Computer-aided design is now an essential part of modern manufacturing but is not to everyone's taste. Industrial modellers more skilled in the creative arts than maths may soon be able to create computer models of their designs with their bare hands – and not an equation in sight.

Many of the stylish products of the modern world, from cars to food mixers, started life as hand-made models crafted by professional model-makers. Using materials such as clay, wood or foamed plastics, model-makers are skilled at turning an abstract vision into a physical object.

But modern manufacturing methods prefer mathematics to clay, so design houses must go through a costly and error-prone process of creating a precise numerical representation of the modeller's work. Would it not be better if the skill of the craftsman could be translated directly into a computer model?

That is exactly what a team of EU researchers hope to achieve. The Touch and Design

(T'nD) project brings together eight industrial and academic partners to bridge this gap between art and engineering.

On the face of it, there should not be a gap at all. Computer-aided design and styling (CAD and CAS) have long been tools of choice, especially in engineering, so there seems no reason why they should not be used to design products without the use of hand-made models. The problem is an aesthetic one – many model-makers find computers too cold and mechanical for their liking and much prefer to feel the emerging artefact taking shape in their hands.

"These people don't know mathematics and don't want to know," explains project coordinator Umberto Cugini, professor of engineering at the Politecnico di Milano, "but they are able to produce what they have in mind with their hands. So our goal was to provide them with the functionality that informatics and mathematics can bring, but via a manual interface."





Sense of touch

The key to the T'nD project is the use of 'haptic' technology which allows a user to feel as well as see a virtual object generated by a computer. A robotic arm transmits forces to the hand of a user, to simulate resistance to movement and can give the sensation of a solid object. To date, haptic devices have only been successful in simulating "point" contact with a virtual object. This is fine for simulating an aircraft joystick or even a surgical instrument, but until now it has not been practicable to simulate extended contact over a surface. To get around this, T'nD uses two coupled haptic devices – supplied by project partner Fokker Control Systems (now Moog FCS) – to simulate the two ends of a sculpting tool.

Two tools have been devised, a scraper, for removing material from a model, and a sandpaper, for smoothing and exploring the surface. Users start with a block of virtual clay, for example, and use the tools to cut and shape it with their hands. They can watch the process on a computer monitor and, most importantly, feel the sensation of the tool cutting and smoothing the clay. Psychologists from the partner Université Aix-Marseille have been closely involved in studying how modellers use tools in this way.

Three other partners in the project – Pininfarina, the famous Italian car design firm, Eiger, a small Spanish company specialising in the design of domestic appliances for big customers like Philips, Siemens and Braun, and Alessi, a designer of household goods – have been testing the prototype along with volunteers from other companies. Students of industrial design in Girona and Milan have taken part in trials to compare T'nD with CAD and traditional hand-modelling to

design a casing for a lap-top computer. "One of the major points that everyone stressed was the very good feedback response," says Cugini. "The feeling was very, very similar to a physical scraper."

Floating in space

The EU-supported phase of T'nD finished at the end of 2006, but the partners are continuing to improve the prototype to the point where it can be commercialised. One major change will be in the display. Rather than viewing the model on a computer monitor, users will be able to see it floating in front of them in three dimensions and work on it with the tools. "We will use a semi-reflective mirror to generate a full stereoscopic image. That was essentially the most critical observation that we had of the prototype."

Moog FCS is collaborating with software partner think3 to launch the product some time in 2008. It is a niche market, confined to specialised bureaux and the design departments of large companies, but T'nD offers the potential to retain skilled craftsmen while greatly simplifying and speeding up the process of getting a design into production. The Japanese automotive industry has shown particular interest and there are plans to showcase the prototype at trade exhibitions in Japan and Korea.

Although the technological elements of T'nD are not new, their combination is unique in industrial design and the team believes that they have a potentially world-beating product in the making. "We are not just upgrading or improving an existing product or technology," Cugini stresses. "In our prototype everything is fully integrated and can be used by a non-technical person to generate a numerical model with their hands. That is something that has not existed until now."



Project name:	Touch and Design (T'nD)
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Policy area:	education and training, transport and energy, enterprise policy, research and technology
EU initiative:	Multimodal interfaces, STREP
T'nD website:	www.kaemart.it/touch-and-design