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Introduction

This poster presents the results of the work carried out in the first phase of the project T'nD Touch and Design (www.kaemart.it/touch-and-design) financially supported by FP6 IST Programme of the European Union.

The project aims at developing a *novel system for shape generation and modification based on novel haptic interaction and intelligent shape manipulation operators* in order to *exploit existing manual skills of designers*.

Current practices in the product design sector include the production of hand-made prototypes created by skilled modelers in order to show and validate the concepts related to a new product. This practice is expensive, requires long time and several loops for execution and modifications, is carried out by skilled craftsmen, and needs downstream activities, like digital model reconstruction, that are not consolidated practices and require time and are error prone.

On the other side, designers using digital tools for representing their ideas are still very few, and anyway, they necessitate physical prototypes for evaluating their ideas. The project end-users (Alessi, Eiger and Pininfarina) have expressed the needs for improving the design process performances, for allowing designers to be put into the overall design process loop and to validate their ideas through physical prototypes they can make themselves, and for allowing modelers to produce digital models out of the physical ones, while preserving their manual skills.

The project aims at providing a system that can be used by both modelers and designers. (Fig. 1). It aims at providing some operating modalities that are familiar to modelers, since resembling the actions they do in the workshop for building physical prototypes. Furthermore, it aims at providing easy-to-use and natural interaction techniques that convince designers to make use of digital tools, and that can be used in an efficient and effective way.

The working modality offered by the T'nD system will allow users to perform operations like scraping material, smoothing and checking surface quality, by using an enhanced CAD tool integrated with an ad hoc developed haptic tool. The system captures and supports the creation and modification of smooth high quality surfaces that can be seen on a screen and also touched. Users will have continuous contact with the object shape during its creation and evaluation.

The T'nD system is conceived in such a way so as to be an everyday working environment that designers and modelers find easy and intuitive to use, useful and productive, and without having to bother about technological aspects, but instead being concentrated on creative activities.

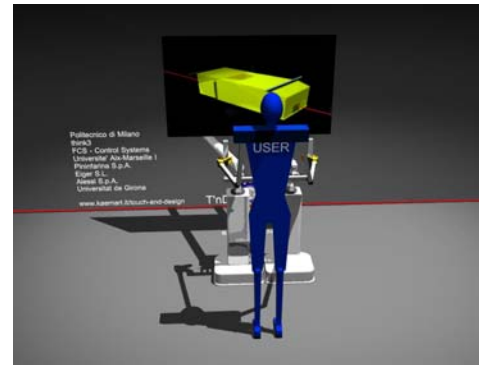


Fig.2: T'nD Scenario

Description

The project has performed the following main activities:

Analysis of design process and critical issues Typical design processes in the industrial design sector have been described and modeled collecting information from, and through interviews done to the end-user partners of the T'nD project that represent two industrial sectors: automotive and domestic appliances. The analysis of the processes have highlighted a list of critical aspects that need to be addressed.

Proposal of solution for improving the process In order to overcome the critical aspects of the design processes, a system satisfying the following requirements has been conceived. The system should:

- be usable by both designers and modelers, exploiting users' skill;
- allow to create, modify and evaluate a shape using both vision and touch;
- provide shape modeling operators that are intuitive to use and performing, and provide in output high quality surfaces (class-A surfaces) immediately re-usable with CAD tools.

System conception In order to design the system we have:

- analyzed the users' skill while molding physical prototypes using hands and identified actions to reproduce in the system: *scraping, surface quality testing and finishing*;
- designed innovative haptic tools supporting the modeling actions: an extended version of FCS HapticMaster (www.fcs-robotics.com) is the most appropriate hardware solution for the project. The FCS HapticMaster is used as basic platform, equipped with a strong and stiff 6-DOF device carrying simulated clay modeling tool with two handles;
- studied new shape generation methods based on sweep-based and voxel-based techniques. The major open issue concerns the definition of an appropriate theory allowing discrete schemes to support fine quality shape generation. The project is developing haptic-based motions and sweep methods supporting the identified actions.

System architecture The architecture of the system is shown in Fig. 3.

Scenarios In order to show the system components and how it operates, some scenarios are defined on the basis of system requirements and short-term and long-term technological goals. The *short-term scenario* demonstrates the use and performances of the T'nD system in shape creation and evaluation (Fig. 2).

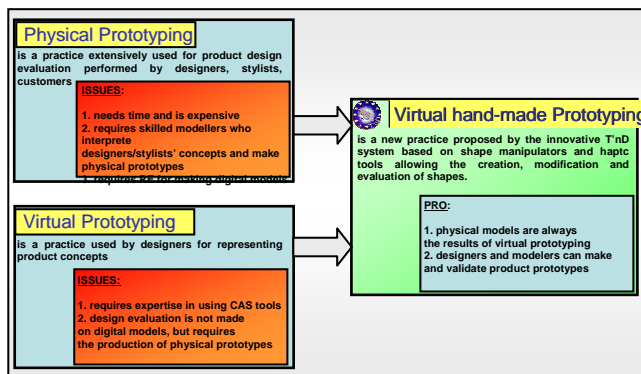


Fig. 1: T'nD concept

Conclusions

The system under development is expected to be a major improvement for industrial design companies that will be able to shorten product design lifecycle, improving design quality, while preserving valuable skills of operators.

Acknowledgments

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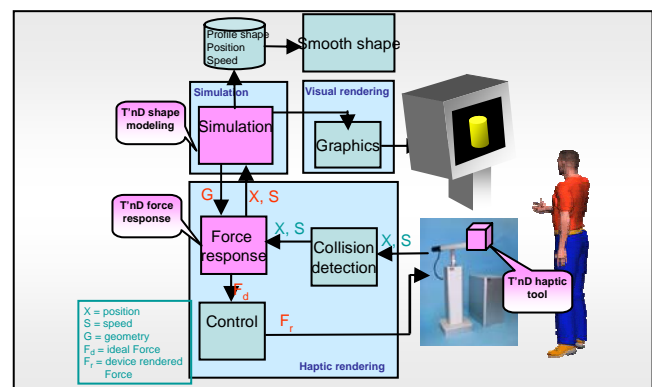


Fig.3: T'nD system architecture