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Exploring Tacit and Tangible Interaction Design: Towards and Intuitive Design Tool

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Abstract— **This [re]search paper is aiming at the identification of essential voids in the support of design processes offered by commonly available methods and tools. Some remarkable results were obtained during design sessions with novices and experts by engaging them in tangible experiments that were designed to stimulate and enhance their skills, tacit knowing and creativity that enable them to represent their ideas and concepts in an intuitive way. We explored and captured the differences in designer's behavior during use of "analogue" and digital representation tools. We will explain our laboratory experiments, test results, educational embedding and creative opportunities that emerge from hybrid design tools. Furthermore we propose an exciting hybrid design tool to bring the tacit and tangible elements of design back into CAD systems. We follow two different routes in our attempt to identify and fill the voids. In the first procedure is a set of observations to measure the effectiveness, various shaping and representation techniques. Knowledge about learning curves, time constraints, idiosyncrasy, quality of design results and focus of particular design methods gives insight in peoples abilities to improve and support decisions about the structure and content of the "best" curriculum for industrial design engineering students. The second procedure is the creation of a prototype of a hybrid design tool to stimulate intuitive and imaginative skills. For the experiments, we used nine (9) haptic representational configurations and set-ups, and involved over 95 participants per experiment. In these configurations the participant's performance of form giving and shaping techniques were captured, observed and rated.**

Keywords- intuitive product design; design work bench; hybrid design tools; virtual design assistant

I. INTRODUCTION

There can be no design activity or process without the use of design representation, i.e. visual or physical. Ideas or fuzzy-notions must be shared with others or oneself and therefore be represented and manifested in some form or way. There are many different ways to represent your ideas or creative thoughts on design issues, these modes and strategies we choose to convey or make visible are closely related to our intuition, tacit knowing, vocation, social-cultural context, education and experiences of how to represent these interim entities.

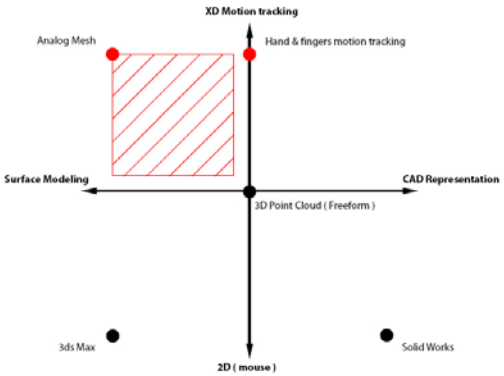

Figure 1. [Re]search framework

II. OBJECTIVE AND APPROACH

A. *Framework*

We created a framework and identified the specific [re]search field for our explorations and experimentation. This allowed us to conduct and fundament our divergent [re]search approach and investigate the large variety in ‘analogue’ and digital representation tools.

B. *Two-Handed Interaction*

As we know, ‘The hands are the instrument of the mind’ or to paraphrase McCullough, ‘Hands are underrated because they are poorly understood’. To work with tangible materials allows the designer to investigate and explore ideas physically, feel the constraints of materials, tinker intuitively and create insight and interact with artifacts that are manifested through manipulation and tacit knowing. We focus our [re]search on the intuitive design of products and tangible representation

through two-handed interaction assisted by ubiquitous computing leading to virtual models created by tangible interaction being transformed into virtual mesh iterations.

III. TANGIBLE EXPERIMENTATION IN EDUCATION AND LABORATORY

A. *Educational Experimentation*

Scaling and 2D to 3D transformation from orthogonal projections of artifacts, into tangible wire frame. Various materials, multiple solutions and idiosyncratic choice architecture emerge from this assignment. "Fig.2"

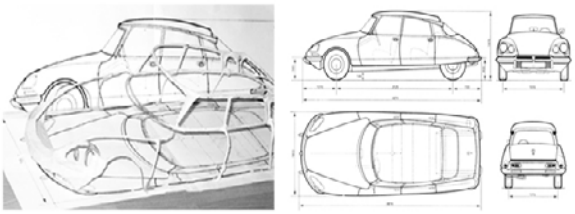

Figure 2. Scaling and Transformation of Artifact

B. *Laboratory Experimentation*

In our laboratory we tested nine (9) haptic representational configurations and set-ups for three-dimensional design representations. "Fig.3"

Figure 3. Haptic Test Benches

We measure the effectiveness and other qualities between abstract and material representation by use of intuition, experience and tacit interaction. The aim is to acquire knowledge and make apparent the emerging inertia and entropy deriving from un-tethered and tethered tool use, stall, high learning curve threshold, tacit knowledge, routines, context constraints, signs of flow, gestures and skill development. In design ideation and conceptualization we look for the unintentional change, serendipity, unpredictability and randomness in shaping and form-giving being oblivious to blind-spots that resonate intentions of design interactions.

C. *Results Nine Haptic Tests*

TABLE I. RESULTS NINE (9) HAPTIC TEST BENCHES

	pencil	sand	steam	sculpting	plying	3d solid	virt.clay	b.tacit	b.tangi.
number of participants	25	38	40	34	28	22	21	79	79
total high speed video test time edited [mm:ss]	26:00	16:00	20:00	25:00	24:00	34:00	46:00	n.a.	n.a.
real total video test time [h:mm:ss]	3:28:00	2:08:00	2:40:00	3:20:00	3:12:00	4:32:00	6:08:00	7:13:00	7:04:00
average test time per participant [mm:ss]	08:19	03:22	04:00	05:53	06:51	12:22	17:31	05:29	05:22

We used Video Interaction Analysis (VIA) (Jordan & Henderson, 1995)

IV. HYBRID TOOL

The Virtual Design Assistant tool (VDA) "Fig. 4" stores and shows all the iterative steps as raw polygon meshes during the design representation process and places them in a solution space library. "Fig. 5"

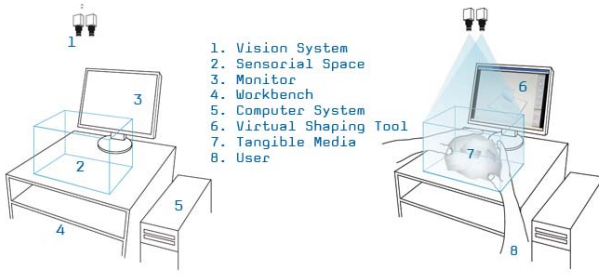

Figure 4. Tangible Workbench + Tool

We created a prototype of a two-handed physical representation Workbench "Fig. 6" with real-time or near-real-time vision-based components that generate polygon-mesh iterations as possible design solutions. Real-time interaction or post-interaction with the various mesh iterations is possible with an un-tethered interface (multi-touch screen) that allows the user (designer) to interact intuitively with the polygon-meshes, blend them or synthesize the solutions. The possibilities of inserting raw functional elements in design iterations leading to multi-layered manufacturing are strong and important features of this tool. to stimulate intuitive and imaginative skills allowing the designer more control, flexibility, flow in interaction, choice architecture, analogue tinkering, manual dexterity and allowing randomness. These elements are essential in behavioural- and user-centred interaction design along with the allowance of intuition and abstract and tangible notions. By starting in the creative or ideation phase we respect the awareness, consciousness and idiosyncrasies of the designer instead of being confronted right from the start by 3D digital modelling constraints and perceived affordance. (ibid. HCI, D. Norman, 1988) www.rawshaping.com

Figure 5. Hybrid Tool | Polygon Mesh Iterations

Figure 6. Prototype Workbench | Tangible and Virtual Interaction