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Short Paper: Design Tools, Hybridization Exploring Intuitive Interaction

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Abstract

Design and Design Engineering is about making abstract representations often based on fuzzy notions, ideas or prerequisite requirements with the use of various design tools. This paper introduces an interactive hybrid design tool to assist and support singular design activity or multiple collaborative creative processing and product creation. It enables the designer or design team to work smoothly with tangible artifacts and traditional design tools. It enables them to freely and intuitively manipulate these objects while simultaneously integrating the iterations into the virtual realm. By loosely-fitting the serendipitous objects, sketches, drawings, images and other data-sets of interest into the design creation process this hybrid tool supports the intuitive interaction and stimulates the immersive experience of augmented reality. The benefits of the system are haptic and intuitive physical interaction evoking the experience of augmented immersion during design activity. Furthermore the computational listing and repository of iterative history allows the users to access fallback choice-architecture and make full use of the hybrid environment and design synthesis capabilities.

Categories and Subject Descriptors (according to ACM CCS): B.6.3 [Design Aids]: Automatic Synthesis - Simulation

1. Introduction

The ideation and conceptualization of ideas and fuzzy notions during design- and product creation processes play an important part in the development of products and communications between designers, design engineering teams and organizations. In all levels of interaction and communication between different players, stakeholders and managers the interpretation of ideas or concepts are often not congruence, well understood or easily accepted due to misinterpretation of data, differences in stakes and viewpoints often caused by data loss or communication breakdowns. With the introduction and emergence of fully digital representation tools the former notion brought about complete new experiences and insights in communicating ideas and creative notions. Some of these constraints were due to stall and latency in software programming or faulty digital equipment. Cumbersome non-intuitive interfaces and peripheral devices cause problems leading to down-time and user frustration. This subsequently also increased the loss in real-world tangibleness and diminished the merit of face-to-face communication. The use of tethered poorly designed interfaces to interact with the software often results in poorer intuitive interactions and lesser tacit understanding. The approach for the design tool we introduce is an interactive hybrid workbench system that supports analogue and digital design interaction and assist in the design communication for single- and multiple players in collaborative settings.

2. Face-to-Face and Human Computer Interaction

We mimic, we reflect, we adapt ourselves continuously to our environment. Our senses are attentive, dose off or are triggered by impulses and cues from the world around us. We react and act according to our understanding and in some cases we move forward on a hunch. We adapt and comply willingly to change, and more often we do not accept change fullheartedly by rejecting the requested adaptation. Designers are known to change their minds continuously and in the spur of the moment being ambiguous in their choices and directions. During ideation and fabrication of full concepts the need for speed and fast iterations is a prerequisite to stimulate the creation process. Representations of ideas by creating abstract visual illustrations of mental models and through the devise of tangible working prototypes ideas are externalized and communicate spatial relationships within contexts.[B04] Traditional analogue design tools still have a place in design representation and interaction, next to the digital design tools.[G&P04]

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ANALOGUE	DIGITAL
FACE-TO-FACE AND BEST PRACTICLE LEARNING	BASIC ELECTRONIC ENTERTAINMENT AND COMMUNICATIONS
frontal lobes executive function	visual and motor
working memory, logic, insight, emotion and body language	sequential-short term memory
variable tempo	faster and faster
often - delayed rewards	immediate rewards
slef - disclosure and openess	limited true self disclosure and anonymity
working memory	captivating graphics and sounds effects - stimilus bound - stimilus driven attention
working memory	simple memory
prioritizing	multitasking and continious partial attention

Figure 1: *Comparison chart Analogue vs. Digital Interaction Environments [MH10]*

Face-to-face interaction [MH10] between designers or multiple players play a strong role during ideation and working with sketchy information. To convey ideas and provoke thoughts by others we look at each other. This interaction between people creates a visual, nudging and tacit understanding [MP66] to evoke a mental picture of the given objective or design task (Fig.1).

According to Don Norman [DN07] we manage well in the natural world, interpreting the signs and signals of the environment and its inhabitants. Our perceptual system conveys a rich sense of space, created from the seamless combination of sights, and sounds, smells and feelings that surround us. Our proprioceptive system conveys information from the semicircular canals of the inner ear and our muscles, tendons, and joints to give us a sense of body location and orientation. We identify events and objects rapidly, often from minimal cues – a brief glimpse or sound, for instance. But more importantly natural signals inform without annoyance, providing a natural, nonintrusive, nonirritating, continuous awareness of the events around us. Based on our research into distributed cognition and the sensory somatic aspects of interaction and behavior combined with analogue and digital representation modes of communication we developed and build the Loosely Fitted Design Synthesizer [LFDS] (Fig 2).

Figure 2: *Prototype of LFDS Hybrid Design Tool*

Through hybridization of traditional and digital design tools we combined the best of both worlds. The LFDS prototype is used in experimental set-ups and real-world cases to study human interaction and human-computer interaction by integrating physical and digital artifacts in the workflow and capture the sessions and iterative content during design processing. The system is particularly suited to support and enhance group design work (collaborative design) when they explore the power of design and communication through physical prototyping or abstract presentations. However, single use of the system is also possible. The interaction takes effect the moment the video input is captured by the user by pushing the button (hand switch) or footswitch record an instance of the iterative process. The appearance and affordance of the switches are intuitively understood by the user, the easy input and data capturing stimulates and enhances the workflow. The instances are shown real-time on the monitor in front of the user. The various iterations are either visible individually or stacked in piles. The layer structure of the instances keep the document stacks timed and historically linked. (Fig. 3)

3. Linking the Real and the Virtual with LFDS

The hybrid interface of the LFDS with a recognizable physical workbench and sensorial space includes digital desktop and electronic tools – intuitive haptic buttons, high-definition camera, monitor and wireless numpad. The Real World and the Virtual Reality are clearly merged. The user will move through the workspace interacting with traditional design tools, paper, photographic images and physical objects naturally and fluidly. [DS92]However, digital data-sets (i.e. documents, CAD drawings, pictures) can be used as well. The real-time captures of the iterations simultaneously supported by the vision system affords the use of both hands during interaction. The hands being the ‘instruments of the mind’ [McC96] allows the designer to investigate and explore

the constraints of materials in all its' splendor. Interaction with materials ignites creative sparks, and the imagination in the brain will follow suit (Fig. 4). [DS92][RW09]

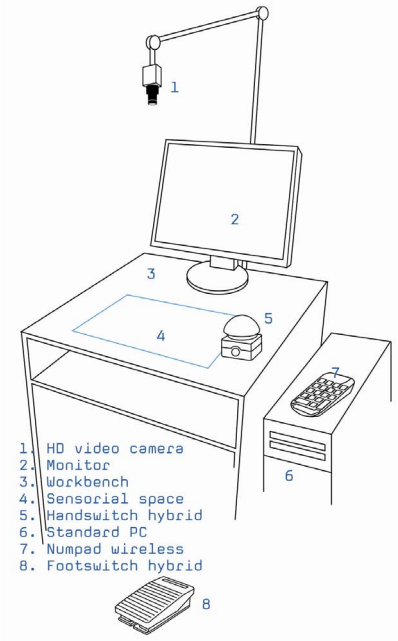

Figure 3: *Set-up of LFDS Hybrid Design Tool*

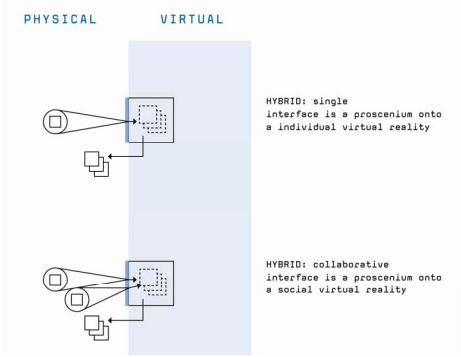

Figure 4: *The two-worlds challenge: linking the physical and the virtual [afterMcC96]*

Processing the iterative information goes uninterrupted and is augmented by the high-definition video camera capturing. The iteration are only stored when the actor physically (button push) makes the capture. The full control lies with the actor and the system assists in the creative process (Fig. 5)

Figure 5: *LFDS Iterative Instances as Visualized by the Hybrid Tool on the Monitor*

To some level the multi-dimensional visuals (instances) are so intense and 'life-like' that the experience of immersion takes effect during interaction. This augmentation is the benefit and contribution of this hybrid design tool. The instances and transformed instances are real-time visualizations on screen. The layer-transparency, instant immediacy and active interaction in the physical and digital domain supports the interaction, design flow and design processing.

4. System Infrastructure and Process

We built and devised the system on COTS components to produce a low-cost and affordable hybrid design tool system. We use a standard Windows PC with XP OS and Input and Output Devices to support the interaction. The software is programmed making use of Open Source platforms. The programming language used is Haxe (haxe.org) together with Neko and Screenweaver (screenweaver.org) of which the Haxe code is compiled to Flash-files for the graphical environment. The save files are in XML format (Fig. 6).

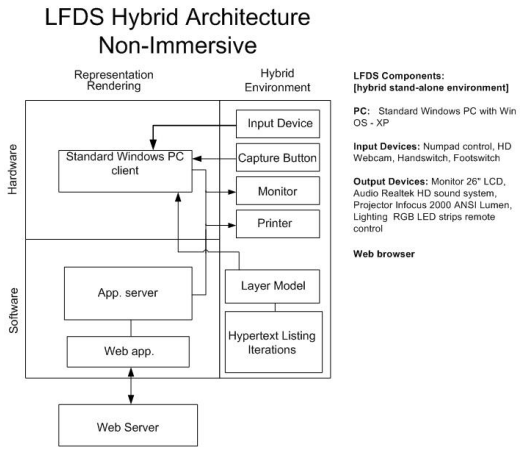

Figure 6: *Hybrid Architecture of the non-immersive LFDS*

5. LSDS: Hybrid Design Tool

The Loosely Fitted Design Synthesizer has a strong metaphorical link with a design office inspirational pegboard, picture wall or serendipitous image-wall (Fig. 7).

Figure 7: *Serendipity Inspiration Wall in Real World Design Environment*

This kind of raw data repository with clippings, image collections and paraphernalia trivial objects clutter the office wall and desktops as a token of memories and tell time in historic layers. These artifacts or objects combined embody a certain serendipitous value and provoke creative ignition in support of design thinking and/or design articulation. On-line searching for inspirational content has similar cognitive triggers. The LFDS has connections to both this analogue wall and the digital wall of sites like i.e. Flicker and Google Images.

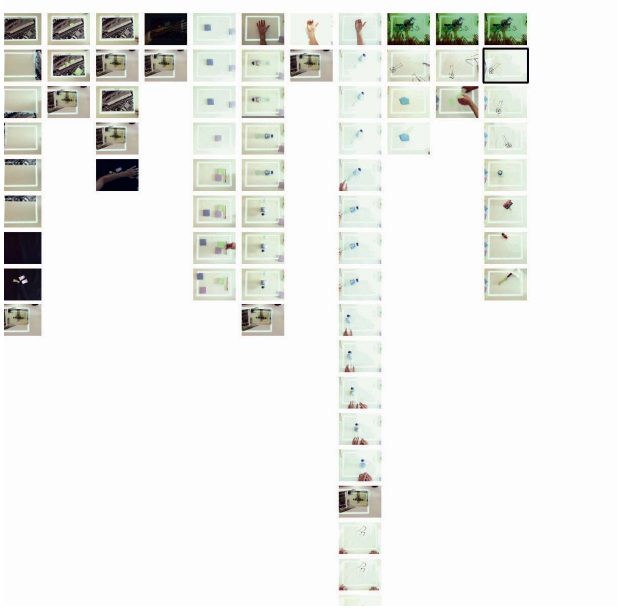

Figure 7: *Iterative Instances Stacks in LFDS Hybrid Environment in Digital Realm*

If we consider the Iterative Stacks as a result of a design process meeting, we can imagine that in the course of this meeting, several players or stakeholders actively presented their ideas and thoughts on the project at hand. Verbal, narrative and visual information analogue or digital is spread openly and shared among the different participants during the meeting, the use of gestures, speech, abstract and exact data will go crisscross from player to player. At the end of the session the players or stakeholders are able to trackback their process and follow the decision-making steps in the listing. The stacks can be sorted in order of importance or functional organization. All the players have access to the digital data and iteration stacks and are able to replay or recall meetings and report on them to others (Fig. 8).

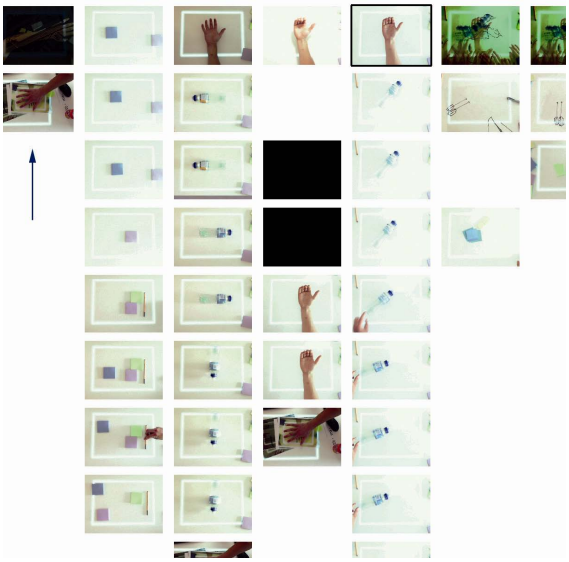

Figure 8: *Iterative Instances Stacked top left (refer arrow) and Loosely Fitted Iterations*

Important stakeholders or other players that were not present can benefit from the virtual visual data-stacks that were generated by the system during the meeting. All the stacks can be loosely-fitted together and stacked in order of agreements made, high-priority topics or otherwise to fit the wishes and demands of the participants or stakeholders. The LFDS can be used as a presentation tool for the next meeting or can be adapted for a specialized meeting for engineers, process managers or others. The various iterations can be printed 2D as a visual representation or fed into the design processing loop as a tangible. Having sharing technology available instantly could be an important feature in collaborative settings. The ability to share the real-time interaction on-line in conjunction with a web application (i.e. Skype) is tested during our experiments and showed promising results.

6. Conclusion

The LFDS system gives promise to intuitive physical interaction (hand and foot) and readiness in terms of real-time interaction transformed into digital information. Our on-going [re]search on synthetic computer environments will enhance the designers' tacit and tangible activities, and extend the repertoires of physical and virtual representation. Our goal is to create tools that work and environments that assist and support the designer to discover and reflect upon his/her own design knowledge and experience. At the same time bring this know-how and experience in contact with other designers, stakeholders or other disciplines. The results with the LFDS tested in real-world cases are promising and has lead to further development of the tool.

7. Future Work

Improve on the capture angle and flexibility of the camera arm to support this. Improve on the drag-and-drop functionality of the individual instances. Saving and exporting files to other platforms will be addressed as well as the possibility to print generated content with 3D printing techniques. In multiple player settings we combine the present system with a projector and a projection screen. A hybrid design tool for use with mobile technology is part of future work

8. Acknowledgement

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