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Development of a technology-based design environment focused on improving user experience

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Abstract

Computer tools usage has became one of the major trends in humanity and product design processes are not stranger to this situation. That is the reason why different computer tools (hardware and software) have been developed in order to support design tasks, enabling design processes to achieve more innovative solutions by offering more time to creativity. Nevertheless, the quantity and variety of available tools bring a high level of complexity and their articulation becomes an important need to be tackled, aiming to integrate hardware and software applications onto a single platform. This article describes the development of a collaborative design environment supported by the usage of computer tools for product design processes. The proposed model is based on the integration of different commercial hardware into a single platform. It is meant to support product design meetings of collocated design teams in a work station where all team members can interact with design concepts in a synchronous way. After the construction of a first functional solution, a redesign process was conducted to develop a platform where key aspects such as functionality, aesthetics and ergonomics were considered. Finally, the proposed solution is not only intended to perform as a stand-alone platform, but also as a networked workstation that will allow distributed design processes.

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Keywords: Collaborative design, Design framework, Technology-based platform, Computer tools, Hardware/Software

1. Introduction

It is characteristic of the human nature to develop tools that help carry out daily activities in an easier and optimal way. It began with the invention of the wheel, and continues with the aid of computers.

Despite this use of different computer tools, the German historian Joseph Weizenbaum mentioned that mankind only uses computers to resolve things that they have already solved once [1]. Although this is true in essence, the innovation promoted by the use of computer tools has not influenced *what* is solved but *how* the task is solved [2].

Related to computer tools usage and their implementation in different knowledge areas, there is a very important question to recall: *how can computer tools be used to support product design processes?*. As regards to this question, many computer tools are used to facilitate product design processes in different fields, such as information and communication management as well as 3D modelling, allowing designers to spend more time on creativity rather than detail [3]. In fact, the usage of computer tools has allowed to increase the success rate of the new products up to 60% [4].

Nevertheless, such usage must be associated to certain design methodologies focused on results, in terms of quality and lead times, and that are needed in the economy of the XXI century. Moreover, it is necessary to integrate these computer tools in order to facilitate the collaborative design process. This integration requires the engagement of new hardware and software technologies and their user interaction.

This work is centred in how computer tools can support different design activities in collaborative teams, integrating different hardware solutions and allowing more time for creativity. Finally, the resulting product product is centred in improving, both, user experience and functionality in order to offer a platform where design tasks can be performed easily.

2. Computer tools supporting product design process

In terms of hardware that can be used in collaborative design processes, several HIT (Human Interface Technologies) can be

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identified, including walls, tables and other surfaces in space to interact with the information, but in an isolated way. This means that if a team wants to use ICT (Information and Communication Technologies) in its design, their must search for different solutions that can be used within the different stages of the PLC (Product Life Cycle). On table 1 a brief classification of the different available HIT to support design processes is presented.

Table 1. HIT classification

Pointers and tablets
Infrared devices
Drawing devices
Touching devices
CAD support devices
VR/AR support devices[5]

Through the analysis of the state of the art [6] in computer tools, the different available solutions in hardware can be analysed as follows: i) HIT allow a more natural interface and allow interaction in a direct and multi-modal way. ii) Groups of people can interact with the same data at the same time and space. iii) They allow users in different locations to interact each other, with the same data set. iv) There are applications using different and innovative interfaces. v) They are conceived to work stand–alone. vi) In terms of cost, there are solutions that can be adjusted to different budgets. In the specific case of touch screens, there is a cost range between 1,000–10,000 Euros by the year of this publication.

3. Development of an integrated design environment

Considering aspects described on section 2, there was a motivation to develop a computer tool able to integrate the different available HIT and centre them into supporting product design processes and to be connected to the specific needs of a design team. It is important that the design team knows the tools, knows how to use the tools and that the tools must be functional but not expensive [7].

Finally, the platform will be based on this insight: *Develop a low cost solution, composed by commercial elements with easy acquisition in local market and propose integration between them and tasks performed during product design processes.*

Regarding the platform development, and following the Pahl & Beitz methodology for conceptual design [8], the first step suggested a functional analysis starting with the high–level black box (figure 1), where all platform's information, material and energy inputs and outputs are related. It is important to recall that some of the inputs are consequence of the interfaces that the framework will use. Additionally, the solution will integrate hardware and software into a novel solution that will support product design processes.

About the interfaces, these should be associated to PLC stages (*e.g.* Need identification, design development, production, distribution, usage, recycling)[9], as well as the moment in which different activities can be performed during each stage. The identified activities are summarized in figure 2.

In this part, hardware must be connected with software and methodologies in order to assure that design tasks, that are being executed within the PLC, are oriented to develop a product. Therefore, in parallel, both platform and framework were developed. Consequently, as an addition to the activities carried out during the design processes (determined by Product Design Methodologies [8,10,11]), it is necessary to analyse and define tools and interfaces for those processes. The list representing the match between tools and interfaces can be observed in figure 3.

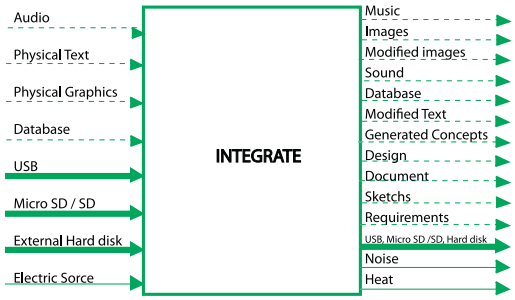

Fig. 1. Platform black box

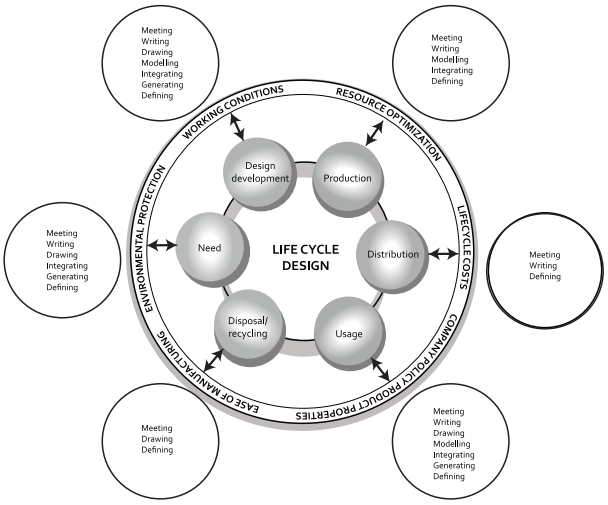

Fig. 2. Design activities through the PLC

Regarding the framework, which is the platform's software component, its development was centred onto a computer tools classification in product design process, which arrange tools according to their usage within PLC. This classification is drawn up from two main categories: i) "Functional tools", which are used in specific activities from different PLC stages (*e.g.* tools for needs identification, tools for conceptual design, etc.) and "Collaborative-work support tools", which are used throughout all stages (*e.g.* Communication tools, Coordination tools, etc.)[12].

Thus, due to the collaborative nature of the design process, the solution should be multitouch in order to support design team simultaneous interaction, including and integrating hardware and software. As the insight considers a low cost solution,