HOW RESEARCH IN PRODUCT DEVELOPMENT CAN ENHANCE THE SYSTEM DESIGN PHASE

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ABSTRACT

Finding financial funding for research in product development is not an easy task. Government agencies all over Europe and the US rather prefer to fund research in applied sciences (technology driven research) rather than research in e.g. human sciences. The Institute of Product Development, Antwerp, Belgium, has been funded many times by the Flemish Agency of Innovation by Science and Technology (IWT) for different research projects focusing on the system design phase. Because of the first conclusion in this abstract the research topics were oriented towards the technical aspects of the product development process and more specific towards the system design phase. This paper deals with three funded research projects that resulted in three tools helping designers to enhance their system designs.

The first project (called SiteView) resulted in a software package to be used in the design of user interfaces. The software can also be used for the analysis of websites. This research used an eye tracker in order to find out where people are gazing at when looking at product user interfaces or looking at the user interfaces on computer screens.

The second research project was investigating the world of the elderly and resulted in a very extensive website with very applicable design rules for elderly. This website was called "AGEtree" and the design guidelines are available for designers dealing with questions like: how do I design visual or auditory components for the elderly, how do I restyle a computer interface that will be used by the elderly …

The third research topic is based on the fascinating world of sensors and their applications. The research was called "SensorTip". The main issue of the research is to investigate what kind of sensor database a product designer needs in order to create new system designs. This research project lasted two years and resulted in a "special" database that offers the designer a solution on questions like: what sensors can I use for measuring the air velocity, can I use the same sensor if I want to measure dirt in waste water … This database is also available on the web.

In all projects the research was focused on interpreting and rearranging available data. No actual tests on sensors were performed to obtain new data. The design rules for products focusing on the elderly were found in the literature and on the Internet. The SiteView project used an eye tracker to perform experimental tests. The available data is huge and it took twelve man-years to finish the research. Important is the fact that the research was almost completely performed by product designers.

Keywords: Product development, research, sensors, elderly, user interfaces, websites

1 SITEVIEW

Human interaction research by using an eye tracker becomes an important feature in the design of future products. Eye tracking registers someone's gaze or pattern by accurately recording the person's eye movements. A scan path is built up that indicates where the user was looking at and for how long. The research project Siteview developed a software tool, called ViewSTAT, that presents the results in a set of clear 'designer-friendly' graphs. ViewSTAT provides the designer with unique insights in the visual usability of products. This software allows designers to optimise the visual qualities of their design, e.g. the layout and the graphical characteristics, the use of colour, the order of the tasks.

1.1 Introduction

Siteview is an organized database, where designers may find a large number of design guidelines, each with detailed information, sources and links. Furthermore, Siteview offers information about design strategies, tools and methods for usability testing, an interactive forum and last but not least: the possibility to download a software package to prepare a user interface or a site to be tested by the usability lab of the department.

In design, there is rarely one strategy which meets all the requirements of a designer or design team. The strategy section of the website briefly reviews a number of design strategies developed in Europe and the US. A design strategy describes the general plan of action for a design project and the sequence of particular activities (i.e. the tactics or design methods) which the designer or the design team expects to take to carry through the plan. To have a strategy is to be aware of where you are going and how you intend to get there. The purpose of having a strategy is to ensure that activities remain realistic with respect to the constrains of time, resources, etc. within which the design team has to work. Many designers seem to operate with no explicit design strategy. However, having no apparent plan of action can be a strategy, of sorts. It might be called a "random search" strategy, and might very well be appropriate in novel design situations of great uncertainty, where the widest possible search for solutions is being made. At the opposite would be a completely predictable or "prefabricated" sequence of well tried-and-tested actions. Such a strategy would be appropriate in familiar and well-known situations. Again, it might not seem to be an explicit strategy, simply because it involves following a well-worn path of conventional activities.

Siteview analyses the visual and ergonomical aspects of a digital interface, using the latest developments in eye tracking technology. After all, the usability of these interfaces is mainly determined by the visual qualities of their design: the layout and the graphical characteristics of the different functions, the use of colour, the chronological order of the tasks. These aspects direct the attention of the user and therefore strongly determine his observing behaviour.

1.2 Eye Tracking

As already mentioned before, eye tracking registers someone's gaze or pattern by accurately recording the eye movements of a test person. This gaze pattern is the objective basis for further visual-ergonomic analysis of user interfaces and websites. During a session, the eye movements are recorded using a special remote camera system positioned underneath the screen. In this set-up, no additional headset is needed. No other technique allows recording someone's rather unconscious viewing pattern. Nevertheless, it directly determines his observation behaviour.

Figure 1. The eye tracker

1.3 ViewSTAT

Siteview developed a software tool to process the eye tracking data statistically, and to present the results in a set of clear 'designer-friendly' graphs. In doing so, ViewSTAT provides the designer with unique insights in the visual usability of user interfaces and websites: what part of the text is read, how many people spot the logo, did anyone look at the banners and if so, for how long, where are people looking for the 'help' function, what areas attract the attention first?

After defining the so-called 'areas of interest' on user interfaces and web pages, these kinds of results are presented in a neat, graphical way, for every single subject as well as for the whole test panel. A perfectly clear start for a thorough, objective analysis of user interfaces and website is thus possible.

The earlier in the design process, the easier (and cheaper) design modifications can be implemented. Usability testing should be integrated in the design process as soon as possible. There is no need to wait till the users themselves test the design. These testings are too important because design changes are painfully expensive at that stage.
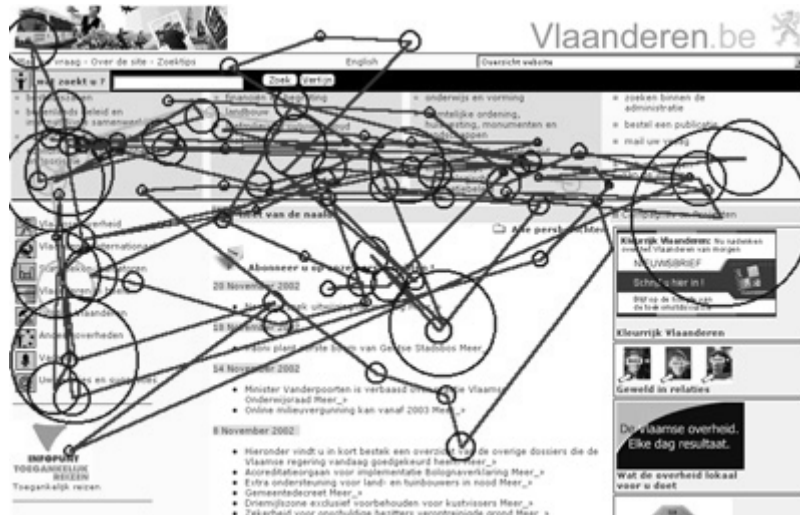
Figure 2. Looking at a website using eye tracking

The research results in:
- an in-depth usability analysis of the user interface or the website
- at any stage of the (visual) design a detailed report with cycle clear presentation of the results
- video recordings with the gaze pattern of every subject (cursor overlay)
- tips and recommendations based on the eye tracking results
- the remarks of an independent test panel and
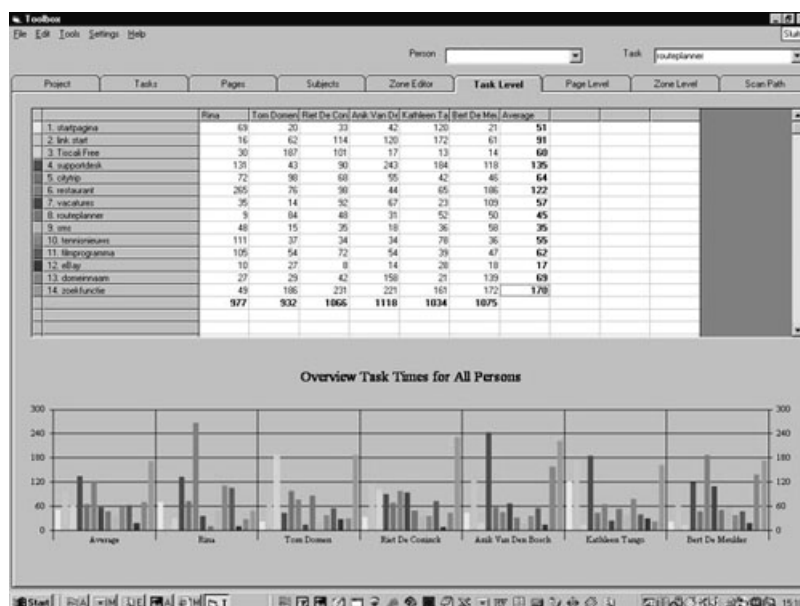- the findings of our own experts solutions on demand

Figure 3. Using the software ViewSTAT

The "tools" section provides the designer with a large collection of user research methods to examine the user's behaviour, feeling, opinions, etc. These methods are described and evaluated in detail on the website. Siteview can provide the designer with information on how to conduct user's research in order to create a successful system design. However, the tools should only be used with expert guidance.

A number of tests and cases performed by the usability lab are also listed on the website. In the test reports descriptions of user preferences on user interface and web texts such as font size, line spacing, aliasing, paragraphs, underlining and background colour are found.

2   AGETREE

AGEtree is a web based application where guidelines are found in order to design products specifically suited for elderly (and also for disabled people). The research took four man-years and was funded by the Flemish Agency of Innovation by Science and Technology (IWT). AGEtree offers designers two possible entries to the guidelines:
-      a user related and
-      a product related entry.

The user entry provides designers with scientific information on human changes resulting from the normal ageing process and translates the changes into guidelines.

The product entry focuses on the designer. The product is split into different product components. Every component results in a checklist of design guidelines. Every guide has a detailed source of information with more cases, resources, links and related human changes.

The tools section provides the designer with a large collection of user research methods to examine his/her behaviour, feeling and opinions. These methods are described and evaluated in detail.

The information provided by AGEtree can give valuable hints on how to conduct a user research in order to create a successful design. However, the tools should, once again, only be used with expert guidance.

There are a number of high level approaches to designing for the elderly which condition the subsequent detailed design process. In design, there is rarely one strategy which meets all the requirements of a designer or design team.

The section on the strategies briefly reviews a number of design strategies developed in the US and Europe to establish and improve the designer's understanding of the needs of older people as well as the issues relating to the enhancement of product usability. Following strategies were developed:
-      design by story-telling, design for a broader average;
-      design to counter decline;
-      healthy industrial design;
-      interdependence of individuals and society;
-      rehabilitation design;
-      strategies for a society for all ages;
-      the interconnectedness of generations;
-      the interdependence of life stages;
-      the owl mark;
-      the 'user pyramid' design approach;
-      through other eyes;
-      transgenerational design and
-      universal design.

In the "case" session a number of AGEtree cases performed by the usability lab are listed. The interaction between elderly, on the one hand, and the computer for electronic voting, the usability of an e-commerce site, and the manipulation of packaging on the other hand was investigated

3   SENSORTIP

This research was also funded by the Flemish Agency of Innovation by Science and Technology (IWT). It also took 4 man-years in order to complete the research. The research resulted in an extensive database of available sensors and their characteristics. It is not a summation of "dull" parameters and technical details. The objective was to provide the designer with a tool to choose sensors for a specific purpose without knowing what physical measuring principle should be used.

In the "cases" section the designer may find examples of materialized or non-realized projects and products where specific sensors perform in measurement principles. A search engine accelerates the search for specific cases.

Measuring principles are found in the following main parameter groups: chemical, electrical, electromagnetic radiation, image-form-colour, magnetic, mechanical and thermal. In each group a

parameter to measure can be chosen. Suppose we want to measure the humidity (chemical parameter group) then the following picture is shown together with the working principle.
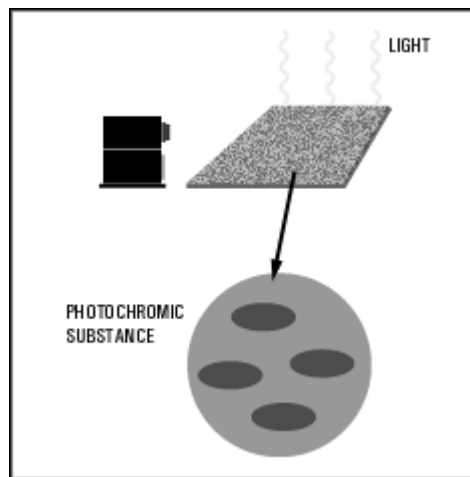

Figure 4. Measuring principle

The designer then finds additional information and also the different possible sensors used to measure the moisture content of a substance, namely the colour sensor and the fibre optic colour sensor. If the designer wants to measure another parameter then he/she will get additional sensors. An excellent system design would then be to choose the same sensor.

For each sensor in the database the minimum and maximum values of the quantity that will be measured, are reported. In this way the database is independent of the suppliers and gives the designer interesting information for making the right choice.

4 CONCLUSION

In this paper it is shown that research in product development has its own 'niche' in the world of scientific research. By presenting three research projects a possible particular approach of this kind of research has been presented. The results are found in three websites:

- www.artesis.be/d-science-demo/siteview
- www.srtesis.be/d-science-demo/agetree
- www.artesis.be/d-science-demo/sensortip

The three projects resulted in very valuable tools for the enhancement of system designs and are available for all designers.

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