Construct, Deconstruct and Reconstruct: Exploring interactive sketching of information appliances

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Abstract: This paper describes an experimental prototyping methodology through a case study of an MSc Major Design project. The experiment examines the potential for combining *VoodooIO*, a "Softwired Flexible User Interface" [10] , with interface prototype authoring software tools including *DENIM*, an informal web site design package [8], as a means of creating early interactive prototypes of information appliances. *DENIM*'s exploration and promise is described as is the eventual substitute software platform choice. Conclusions are drawn, identifying elements from the experimental methodology that showed significant strength and potential and those in need of development. Conclusions and lessons learned from the work have since fed into a PhD investigation into the effectiveness of rapid low fidelity prototyping techniques on the design development of information appliances and this is briefly outlined.

Key words: Low-fidelity interactive prototyping, Information appliance design, product design, design methodologies, prototyping methodologies

1. Introduction

This paper examines the potential of combining *VoodooIO*, a "Softwired Flexible User Interface" [10], with interface prototype authoring software vehicles including *DENIM*, an informal web site design tool [8], as a means of creating early interactive prototypes of information appliances. While there has been much work on the development of design methodologies for information appliances, including Phidgets [5], Switcheroos [1] and Paper Prototyping [9] and while projects such as d.Tools [6] have approached the hardware and software elements in tandem, there are none that allow the speed and flexibility designers really need. Gill *et al.* [4] found that for a prototyping system to achieve successful adoption by industry it must provide a good fit into the designer's process and allow low fidelity prototyping in between 1 and 2 hours. Further, they found that users should require no electronics knowledge, no knowledge of programming and that the system should be very easy to learn. Through the case study below this paper suggests some possible routes towards this goal. The work took place during a 3 month industrial placement by the lead author at *The National Centre for Product Design & Development Research (PDR)*. The brief was to develop a conceptual digital camera into a final design, partially informing the design through the implementation of interactive prototyping methodologies developed within one of PDR's research groups, the *Programme for Advanced Interactive Prototyping Research (PAIPR*).

2. Background

VoodooIO [10] was developed by Lancaster University, based on their Pin & Play *ad hoc* networking technology. Developed as a flexible physical user interface, *VoodooIO* allows users to re-position user interface controls by pushing them into a networking substrate. Each control has a unique ID allowing the user to assign an input value via the *VoodooIO* software interface.

DENIM [8] is a software development tool for sketching website outlines quickly and intuitively. *DENIM* uses a state transition diagram metaphor to construct interface prototypes that can be interacted with as if inside a web browser. The potential of *DENIM* in the information appliance development field was identified by *PAIPR*, and in 2004 they had an open source version of *DENIM* customised to allow state transitions to be triggered via the keyboard. This made *DENIM* compatible with the *IE System* [2] - an information appliance prototyping system based on translating a prototype model's control inputs into computer keyboard inputs. *VoodooIO* was also supplemented with code to allow it to interact with the modified version of *DENIM*[1], and although the system had been tried via a proof of concept demonstration and showed promise, it had not been trialled in a real design project. The lead author elected to use these techniques on the project described below.

3. Method

A design project undertaken during an industrial design placement by the lead author afforded an opportunity to trial the technique in a real design project. Early state transition diagrams of the user interface were created using *DENIM* (*See Figure 1a*). The resulting interactive software prototype was used in conjunction with *VoodooIO* to create a software interface triggered by a tangible interactive prototype (*See Figure 1b*). The interaction between the two was facilitated by a programme written by Nicolas Villar, who developed *VoodooIO*. This programme allows *VoodooIO* to be easily programmed to output ASCII codes which in turn allow its controls to trigger the modified version of *DENIM*. The potential for this system was clear; it allowed for very fast prototyping and was a good fit for designers' traditional sketch development-based techniques. Unfortunately, *DENIM* quickly became increasingly unstable as the interface grew. The principle of its potential however had been demonstrated, but as a practical design tool the *DENIM* - *VoodooIO* combination was not yet ready for use. Unfortunately this lead to the need to use traditional methods of creating state transition diagrams by using post-it notes to complete the early iterations of the user interface.

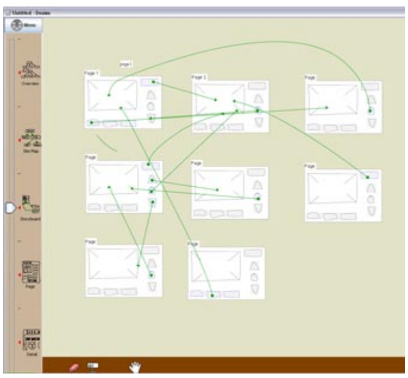

Figure 1a. – DENIM interface design

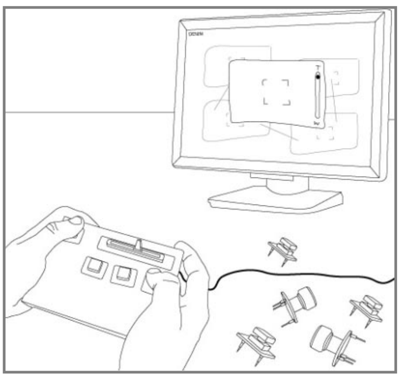

Figure 1b. – DENIM – *VoodooIO*

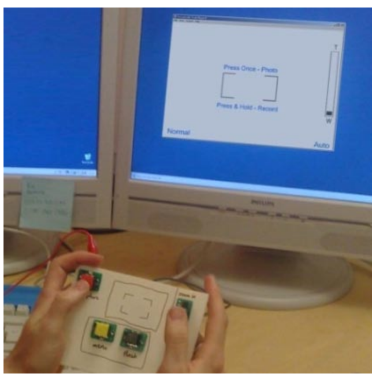

Figure 1c. – Flash & VoodooIO

1 (see http://uk.youtube.com/watch?v=Yl0oYl8S-bU)

The stability issues with *DENIM* meant that a replacement software platform was needed to work with *VoodooIO*. *Adobe Flash 8* was chosen for a number of reasons including its capabilities, familiarity to *PAIPR*, and more importantly, its high level of use by designers within industry. The very fast sketch methodology linked to a state transition metaphor was unfortunately now lost. However *Flash* combined with *VoodooIO* would still help to explore the concept of interactive sketch prototyping at an early stage in the design process albeit that some programming was now required to allow the interface to respond to specific keyboard interrupts. At this stage in the design process a low fidelity level was used to ensure the focus of development remained on the intended issues of navigation and interaction (*See Figure 1c*). The decision was heavily influenced by informal understanding within the group of the relative importance of physicality and fidelity, since proven in empirical trials [3].

4. Discussion

A successful design process was facilitated by both *VoodooIO - DENIM* and *VoodooIO - Flash* hybrids. It was clear that a toolkit with the very fast and fluid sketched state transition elements of *DENIM*, coupled to a system that allows for a similar approach at the physical prototyping end of the process to that offered by *VoodooIO,* has great potential to fit with designers' methods and required timescales. *DENIM*'s sketch based method of interaction eliminated the need for programming. This is an important asset of a tool for use by designers. Such a tool allows designers to be flexible in representing the design. *VoodooIO* enables the interactive input elements to be quickly added, removed and replaced. It also eliminates the need for electronics knowledge. For all their plus points however, there are also features of both *DENIM* and *VoodooIO* that would require significant alteration to make them ideal for information appliance design.

Although it showed great promise, *DENIM* quickly became unstable as the interface grew beyond the first few states. Additionally, Hartmann *et al.* [6] noted the importance of being able to extend a low fidelity interface towards higher fidelity levels as the design develops. *DENIM* does not support this ability, whereas *Flash* does. *Flash* also has the twin advantages being a design industry standard and very stable, although it does require some programming knowledge for the application described here.

Although *VoodooIO* allowed very fast and flexible physical prototyping, it too had limitations in this particular type of application. The first of these was scale. Both Hartmann *et al.* [6] and Hudson & Mankoff [7] emphasised the importance of a small form factor in interactive prototyping systems and also backed by *PAIPR*'s findings on physicality. The scale of a handheld product critically influences the user's interaction experience, although this is often overlooked by researchers. *VoodooIO* was not designed for this type of application and so its controls are oversized. As a result the prototype was around twice the intended size of the concept. As well as ergonomic analysis limitations, this also increased the chance of errors based on user test data because the size of the product influences the way it is held and operated. Another major limitation of *VoodooIO* in this type of application is that it is essentially a two dimensional product. Fortunately the designs being explored in this case only featured input controls on one face of the product but many information appliances feature controls on multiple surfaces and in some cases do not feature flat surfaces. Attempting to "wrap" the *VoodooIO* substrate around a small organic form would be problematic. Finally, the authors' noted that *VoodooIO*'s limited component library imposed limitations on the designer. A vastly more varied library of controls at a variety of scales would therefore be a minimum requirement of a toolkit for information appliance development.

5. Conclusions & Future Work

The *DENIM – VoodooIO* hybrid toolkit demonstrated great potential in fitting seamlessly into current prototyping practices of designers, however, neither are currently suited for information appliance design. The *Flash – VoodooIO* combination offered stability and also allowed progression of fidelity, but also had limitations of its own. Among these was the need for programming knowledge and the timeline metaphor which was not as well suited to this type of work when compared to a state transition metaphor. Future work should examine some of *DENIM*'s positive attributes and consider a *DENIM*-like plug in for *Flash.* Regarding *VoodooIO's* potential for this type of application, the speed and ease of configuring controls and replacing elements are major benefits, whilst the scale, range of controls and even greater, the 3D adaptation of the substrate are key challenges. The lessons learned from this work have led to a PhD study undertaken by the lead author which aims to investigate the effectiveness of rapid low fidelity prototyping techniques on the design development of information appliances.

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