Addressing Multi-platform Collaborative Sketching

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ABSTRACT
Prototypes are essential tools for design activities for they allow designers to realize and evaluate ideas in early stages of the development. Sketching is a primary tool for constructing prototypes of interactive systems and has been used in developing low-fidelity prototypes for a long time. The computational support for sketching has been receiving a recurrence of interest in the last 45 years and again nowadays within the mobile web context, where there are diverse devices to be considered.

The research reported on this paper aims at addressing issues on multi-platform collaborative sketching using a prototyping tool for user interfaces. The tool was built to aid the investigation on how designers sketch using many different devices and collaborate using their sketches during design sessions.

Author Keywords
Electronic sketching; Multi-platform systems; Collaborative design; Prototyping.

ACM Classification Keywords
H.5.2 User Interfaces: Prototyping

INTRODUCTION

A prototype is a working model built to develop and test design ideas. In User Interface design, prototypes are essential tools for fostering discussion regarding both interface and interaction with stakeholders. Techniques such as Paper Prototyping [16] became very popular due to its' low cost and efficiency, since they are made using sketches for quick generation of prototypes.

Lately, there has been a recurrence of interest on supporting electronic sketching (i.e. sketching at electronic devices and interactive surfaces), and despite sketching *recognition* to be fairly well addressed on the literature, the adoption of electronic sketching as a *design tool* is still a challenge [7]. The current popularization of touch screen devices and the multi-platform capabilities made possible by using HTML5 might pose new opportunities for researchers to explore, for instance, how designers use sketching to prototype interfaces for a target device by producing and testing them on the device itself.

When designing, people draw things in different ways, which allows them to also perceive the problem in new ways. People engage in a sort of 'conversation' with their sketches in a tight cycle of drawing, understanding, and interpreting [14]. When prototyping by using the target device, other elements come into play in that conversation. Nowadays, there are many devices available for designers to sketch upon [9], with different screen sizes, weight and processing capabilities; this is a fact to be addressed into contemporary sketching research.

We introduce GAMBIT (Gatherings and Meetings with Beamers and Interactive Tablets), a multi-platform system for constructing prototypes that allows the construction and testing of interfaces on the very device it is intented to run. The system was built with HTML5 and Javascript in order to run on any device with browsing capabilities, aiming at addressing multi-platform sketching support in collaborative design sessions.

In this work we define an approach that is:

1. Sketch-based - electronic sketching is supported as the main mode of interaction, it is used to quickly put ideas on an external medium, where they can be discussed, improved and stored for further reference [4];
2. Multi-platform - for it allows users to sketch using the device of their preference, and also allows the prototyping and testing of systems for a device on the very device it is intented to run;
3. Collaborative - for it focus on group sessions, allowing not only designers to sketch and discuss together, but also to include end users in the process.

SKETCHING IN USER INTERFACE DESIGN

Sketching is considered to be a powerful tool for doing design. As the findings of [5] point out, the presence of ambiguity in early stages of design broads the spectrum of solutions that are considered and tends to deliver a design of higher quality.

As for the fundamentals of sketching, Van der Lugt's work [17] conducted an experiment to analyze the functions of sketching in design, in which participants produced individual sketches and then presented them for the group for discussion. Three primary sketching functions were identified:

F1 Sketching stimulates a re-interpretive cycle in the individual designer's idea generation process: Schon and Wiggins

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[13] describe design as a cyclic process of sketching, interpreting and taking the sketches further.

F2 Sketching stimulates the designers to re-interpret each other's ideas: when sketching to also discuss (as opposed to sketch for self-interpretation), the designer invites others to interpret her drawings as well. The function of inviting re-interpretation is especially relevant for the idea generation process, as re-interpretation leads to novel directions for generating ideas [17].

F3 Sketching stimulates the use of earlier ideas by enhancing their accessibility: Since it is externalized, sketching also facilitate archiving and retrieval of design information.

UI design by sketching is recognized for several proved virtues such as, but not limited to: maintaining an informal representation to foster creativity [3] [11] [10], complementarity between paper and pencil and software [1] [17], capability to take one design idea at a time and work it out in details or consider alternative designs at a time (i.e. lateral transformation [10]), ability to reveal as much usability problems as if it was a real UI [6].

In order to support sketching into UI design, we needed to analyze the process in which UI design is included. Currently, the development life cycle of interactive applications consists of a sophisticated process that does not always proceed linearly in a predefined way. The tools available for UI development are usually not focused on UI **design**, in which designers usually explore different alternatives but in UI **modeling** as a final product, where designers must attend to formal standards and notations.

There are many tools available for both modeling and design, however practitioners are currently forced to choose formal and flexible tools. Whichever they choose, they lose the advantages of the other, with attendant loss of productivity and sometimes of traceability and quality.

As the study reported [2] mentions, designers desire an intelligent whiteboard because it would not require hard mental operations while sketching during meetings and design sessions.

However, electronic sketching is still behind the classical sketching in paper, since the tool in use becomes too evident [18]. Perhaps until the gap between displays and paper are minimized, (for instance with paper-like displays[15]), this distance will continue high, hindering the designer's 'conversation'.

Calico [10] and DENIM [11] are good examples of "vanishing tools" since they keep out of the way between the designers and the problem at hand, and this can be useful especially during early design stages.

Therefore, fostering creativity is specially important since design is essentiallly a problem of *wicked nature*, i.e. the process of solving it is identical with the process of understanding it [12]. In wicked problems, the designer does not have a clear understanding of what to produce and has only a vague goal in mind in the beginning.

RESEARCH AGENDA

Electronic sketching has some important advantages over classical 'pen and paper' approach. While sketches are useful to facilitate discussions on the conceptual level, computer prototypes are useful for discussing operational and interaction issues [6]. Therefore, both aspects (raw sketches and interactive prototypes) are complementary, and a sort of hybrid approach is considered to be useful since it allows designers to explore alternative solutions for the same problem [10, 5].

The goal of this research is to advance the state of the art regarding electronic sketching usage in current design practices taking into account the diverse multi-platform context. The first step of the research is the GAMBIT system itself, as an alternative tool that explores the multi-platform context.

One important issue with currently sketch-based systems for prototyping of user interfaces is that they are *single-platform*, since they are usually made to be used on Desktop computers [11, 10], even though the prototypes are targeted at multiple devices [8].

We argue that a more complete prototyping system would allow sketching and simulation on the target device, enriching both designers' and users' experience with an interactive prototype, allowing them finally to have a richer *conversation* with the working design at hand.

The main research issues to be accounted at this research are:

Electronic sketching as a tool A designer could sketch and test user interfaces for many platforms using just a single platform such as a large sketching device (e.g. Wacom, TabletPC). However, the main benefit of sketching as a tol for prototyping is to allow us to 'see as' and 'see that' [14]. That benefit is hindered since only the size of the target device is being considered, while there are other significant factors such as weight, screen resolution, brigthness and interaction modes (e.g. multi-touch, WIMP).

How the *conversation* is perceived to change from different approaches (single-platform and multi-platform sketching)? Experiments can be conducted comparing prototypes produced with tools such as DAMASK [8] (a single-platform tool for multi-platform prototyping) and our tool.

Sketching devices as a medium Among the available devices, which of them are suitable for sketching? Given that there are many differences in terms of performance according to the device type, how users perceive the different features inherent to each device, such as *lag*?

We argue that in order to start an investigation of electronic sketching on that diverse context, an acceptable **lowest limit** for sketching rendering speed needs to be properly investigated.

Sketching Recognition Considering an eventual sketching recognition mechanism, how the different inputs delivered by the different devices differ? What kind of adaptation a sketch recognition system needs to perform in order to correctly recognize inputs from the same user on different devices?

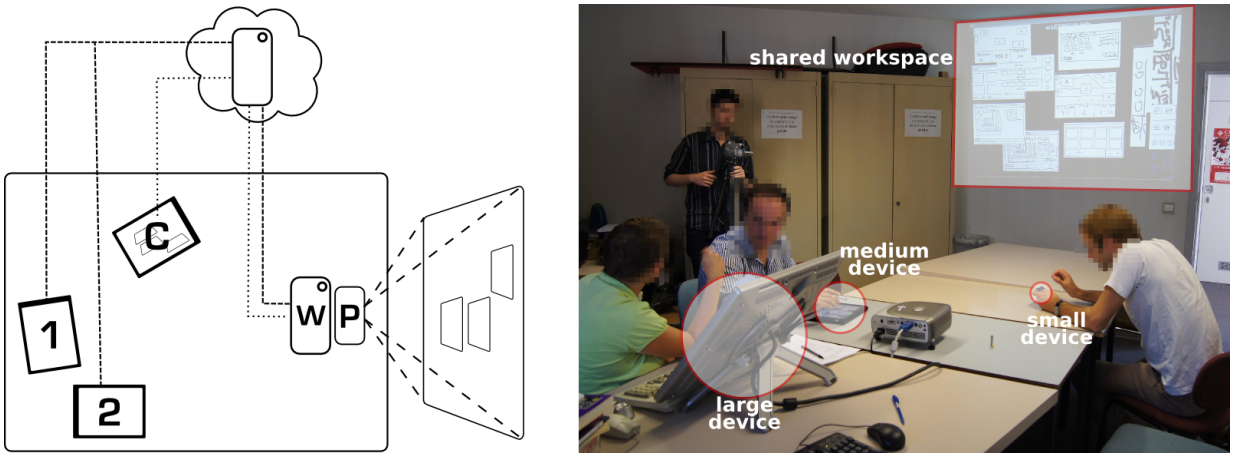

Figure 1. Physical setup of GAMBIT.

MULTI-PLATFORM SKETCHING ENVIRONMENT

The tool support for the investigation is the GAMBIT system, a distributed software environment designed to be physically deployed around a table, with tablets and a projector. It is multi-platform since it is essentially an embedded website, which might be used through a browser or through a native mobile application (i.e. a 'wrapper' application).

The system is currently developed as depicted on Figure 1: the many input devices (1 and 2 in the figure) can be tablets, mobile devices, large graphical tablets, etc. They are used by designers to sketch and submit drawings to the device representing the wall (W) showing the sketches as if they are real sheets of papers organized onto a real wall.

The wall is projected using a common projector (P) and can be controlled using a tablet, called 'control tablet' (C). The roles of the devices are interchangeable – a user might request the wall's control at any time, organizing and grouping the sketches. Since GAMBIT is a web-based system operating through a browser, the wall (W) might be a full-screen browser window opened on a desktop computer, a projection or a large interactive display.

Figure 1 (left) shows the deploy scheme of the system, with designers using different devices each around a projector in the middle. In the right part the wall shows the sketches being organized with the control tablet.

Figure 1 (right) shows a picture taken during a preliminary study with designers from one software development company. That experiment showed indications regarding designers' preferences of device types for different activities, and it is one of the expected outcomes of the tool.

The system was developed in HTML5 in order to centralize the code for different platforms. In this sense, the system can run on any device with a browser. Figure 2 (front) shows the sketching interface of the system, with a drawing area that uses HTML5 <canvas> element and Javascript routines to capture the mouse/pen/touch events.

The left part shows a toolbar that can be used to switch from

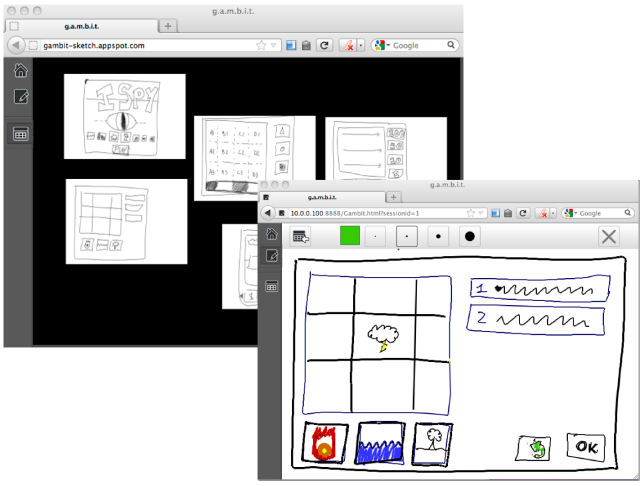

Figure 2. GAMBIT interfaces for sketch production and "Wall sharing".

sketching to control functionalities. Figure 2 (back) shows the wall being displayed, with the sketches arranged like sheets of paper that can be dragged and grouped. The black background is intentionally put in order to make only the "sheets" to be projected on the wall.

CONCLUSION

This paper introduced GAMBIT and a research agenda for investigating electronic sketching and its usage in current design practices taking into account the diverse multi-platform context.

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