Towards Fast and Interactive Prototypes of Mobile Apps

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ABSTRACT

With the advent of modern mobile phones and tablet devices unprecedented opportunities arise to create rich user experiences that incorporate the context in which the interaction is situated. Sensors and other built-in technologies provide designers with a variety of possibilities for new and exciting applications. Since building such applications requires specialists there is an increasing demand for tools supporting people without programming skills to access, explore and design for the opportunities of mobile devices. In this paper we present a novel prototyping system named *FamOz* that combines the ease of paper prototyping with the efficiency of *Wizard of Oz* while exploiting the interactivity offered by new mobile devices. *FamOz* allows designers and researchers to evaluate mobile prototypes in situated real-world settings in an early stage of development.

Author Keywords

Design; Design process; Method; Mobile; Prototyping; Wizard of Oz

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

Mobile devices offer a growing set of high quality sensor and display capabilities that form the basis of novel interaction concepts for mobile applications. Shaking the mobile device, for example, can constitute a plausible metaphor for a rolling dices application; moreover, the same gesture can also be utilized as an intuitive metaphor for denying incoming calls. The need to *situate* such interactions and hardware features based on *people's needs* via easy-to-make and cheap prototypes, however, remains as a challenge for designers (Sá and Churchill, 2012).

In this paper, we present the concept design of *FamOz* ('Fast Mobile Wizard of Ozzing'), a prototyping tool for mobile devices that we implemented for Android. *FamOz* combines the convenience of paper prototypes with the interactivity offered by modern mobile phones by utilizing the *Wizard of Oz* technique. It helps non-programmers to prototype easily and cost effectively, and to 'move' with these applications to real-world contexts for evaluation. We describe the architecture of *FamOz* and provide scenarios for illustrating how the system can enhance the understanding of future mobile interactions.

FamOz targets the research gap of supporting a wide range of the production cycle from the preparation of a task to its *in-situ* evaluation without relying on additional hardware or software. Consequently, *FamOz* allows content creation and organization *on-the-fly* which in turn enables the *Wizard* to respond to the participants both individually and instantly.

Before we go on we briefly introduce related work focusing on prototyping techniques and on user research that aims at understanding people's needs in their daily life.

PROTOTYPING FOR DESIGNING MOBILE APPS

Low-fi techniques such as paper prototyping with Wizard of Oz testing in lab environments are powerful tools in evaluating early interaction and interface ideas without being limited by pre-defined elements (Bolchini et. al., 2009; Chandler et. al., 2002). Such techniques have the major advantage for designers to simulate essential processes and interaction 'behind the curtain' (Li et. al., 2010; Linnell et. al., 2012). In recent years a small number of prototyping tools utilizing the Wizard of Oz technique for mobile phones were proposed. Each of them emphasized a particular aspect like the validity of the results (Lim et. al., 2006), the contextual involvement of the *Wizard* (Grill et. al., 2012) or the organizational problems of the Wizard of Oz technique (Churchill et. al., 2010; Schlögl et. al., 2011). Other researchers combined Wizard of Oz components with paper prototyping, thus, bringing paper prototyping to the digital world (Li et. al., 2010) and opening new realms such as multi-display environments (Bailey et. al., 2008).

However, low-fi prototypes do not provide the necessary affordances or fidelity of experience for the user and high-fi prototypes limit the creative engagement of the participants (Raento et. al., 2005). Balancing the shortcomings of the distinct prototype approaches will remain a challenge. Further issues of a practicable prototyping tool comprise how the *Wizard* cognitively copes with the information and how the *Wizard* can be supported to react to the users input swiftly (Davis et. al., 2007). These considerations are especially important when studying novel mobile applications 'in the wild'. Understanding the user when interacting *in-situ* will remain a crucial factor in the design of novel interfaces and interactions for the mobile domain and ubiquitous computing.

With *FamOz* we propose a mobile prototyping system that combines the advantages of various prototyping

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approaches, while avoiding some the shortcomings. *FamOz* provides researchers with a tool for the rapid implementation of mobile prototypes with optimized Wizard of Oz support, and assists in delivering a high fidelity user experience. As it is designed 'for the wild', it can be used to study the user in situated contexts and hence, contributes to the research outlined in the next section.

EXPLORING MOBILE INTERACTIONS WITH PEOPLE IN THEIR USE CONTEXTS

Due to growing needs in mobile application contexts and the affordances of new technologies, several innovative hybrid design methods for mobile applications were developed to combine user insights with research outcomes. Various techniques were introduced to understand people by studying their use of mobile technologies for gathering data (Hagen et. al., 2005). Examples of such techniques are technology probes (Hutchinson et. al., 2003) and elaborated mixed ethnography where advanced feedback and reflection mechanisms through the installed technologies capture daily life and the reflection upon it (Riche et. al., 2008).

Moreover, the importance of mixed fidelity prototyping for enhancing the design space in early design stages of mobile technologies was discussed by Sá et. al. (2008). A method called video prototyping was introduced as an inexpensive early solution for exploring the potentials of *augmented reality* technologies (Sá et. al., 2011). Explorative prototypes such as the augmented ethnography kit (Churchill et. al., 2010) were developed and used for collecting everyday data *on the go* based on various sensors worn by the participants.

These and similar approaches are important advances as we lack techniques for understanding "the unique features and constraints that ubiquity, pervasiveness and the devices' physical characteristics introduce" (Sá and Carrico, 2012). The *FamOz* system, as described in the next section, is our response to the need for inexpensive, effective and powerful tools for studying the use of mobile apps *in-situ*.

THE FAMOZ SYSTEM

Combining Wizard of Oz with paper prototyping, while adding the capabilities offered by modern mobile devices within a single prototyping tool, brings several benefits for researchers and designers: (1) it enables easy prototyping in real world settings, (2) it allows access to sensors and actuators without programming knowledge, (3) it enables a more seamless user interface (UI) and user experience independent of pre-defined interface elements or interaction sequences, (4) studies can be conducted *in-situ* without being dependent on a heavily equipped laboratory. These opportunities open interesting possibilities such as moving out of the lab environment and exploring participants where *real* interactions take place.

FamOz is our contribution to extending existing prototyping techniques to mobile and sensor rich *in-situ* prototyping. It facilitates the prototyping of mobile phone and tablet applications and enhances them with modern

Figure 1. The *participant's* mobile phone (background) and the tablet computer of the *Wizard* (foreground) are paired wirelessly. Input of the *participant* is displayed on the *Wizard's* device ('live-view'), where the *Wizard* can react to it remotely.

sensors and actuators as offered by these devices. Thereby, *FamOz* addresses a target group that is interested in designing and evaluating new interfaces rather than in implementing software. Thus, the proposed system (*FamOz*) conceals technical details while offering a broad variety of interaction mechanisms.

As a piece of software *FamOz* provides the *Wizard* with tools for the remote-monitoring of the *participant's* current (real time) device interactions (e.g., tilting the *participants'* device, touching the screen) and for the remote-triggering of actions on the *participant's* device like switching screens or starting vibration alerts (see Illustration in Figure 1).

The system comprises three hierarchical and conceptual layers. The lower two layers hide communication and sensor details from the UI designer whereas the third layer offers screen utilities for building the interfaces to be tested *in-situ*.

Layer 1 - Communication

Prerequisites for using *FamOz* are at least two Android devices paired via *WiFi* – one device assigned to the *Wizard* and one device to the *participant.* This assignment constitutes the first step in setting up *FamOz.* In a second step, the communication between the devices is finalized semi-automatically. We go on to explain technical details of setting up *FamOz* with an example (see Figure 2 to follow the example step-by-step). This example ought also aid the reader in understanding the interplay and structure of the three physical components of the *FamOz* system (mobile device of the *participant*, mobile device of the *Wizard*, and utility server).

We set the first device as the *participant's* device (1) as shown in Figure 2 (see next page), where the *participant's* device displays its IP address and editable name (e.g., "ZEBRA") (2). The device sends its IP and name to the server (3). The IP of the server is known by *FamOz* as a default value and can be edited. The second device is set as the *Wizard's* device (4). The device is set and shows its IP and editable name (e.g., "ZULU") (5). The device sends its IP and name to the server (6). The server sends a list of connected *participant* devices to the *Wizard's* device (7). The *Wizard* selects a *participant's* device and sends the selection to the server (8). The server sends name and IP to the devices (9). After this introduction both devices dispose of each other's name and IP address. From that moment on they can communicate either directly or via the server as a relay and the setup is complete. This procedure does not require any technical knowledge and can be carried out within a few minutes. It has to be performed only once.

The server is a software component built in the *participant's* and *Wizard's* device. It is depicted as a separate device only for clarification.

Layer 2 – Sensors, Actuators and Intents

Sensor data of the *participant's* device are sent to the *Wizard's* device as a constant stream. To reduce the amount of data, sensors can be activated and deactivated. *FamOz* features the following sensor data: accelerometer, position, ambient light, compass, microphone and camera. Actuators comprise the vibration-motor and the speaker. *Intents* are an Android specific concept for calling system functions and other applications to gather data or to perform certain actions such as showing the software keyboard. Both, actuators and *intents*, on the *participant's* device can be triggered remotely from the *Wizard's* device by pressing the associated *FamOz* UI button.

Layer 3 – User Interface

The concept of the Wizard of Oz method is to use human cognition for perceiving and reacting to complex unstructured data. As the *Wizard* has to mimic the system's logic, the UIs of the *participant's* device and of the *Wizard's* device differ. The *participant* interacts with screens selected by the *Wizard.* Thus, the *participant's* UI

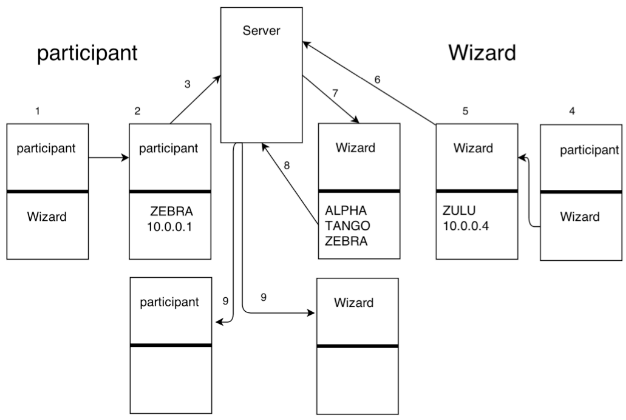

Figure 2. Pairing two devices (*participant* and *Wizard*).

Figure 3. Illustration of the UI of the *Wizard's* device. Left: the current content of the *participant's* screen. Right: Internet browser for retrieving data from the Internet.

is basically a remote display for screens that are chosen by the *Wizard.* The *participant's* screen interactions and touch inputs are transmitted back to the *Wizard's* device instantly and are displayed as a map-overlay indicating the 'touch positions'. The *Wizard,* on the other hand, responds to and manages both *participant* and sensor input. Depending on the input, the *Wizard* decides what screen (i.e., sketch, see next paragraph) and what information is to be delivered to the *participant* and initializes this action. The *Wizard's* device features two main functions for supporting the selection of sketches to be displayed on the *participant's* device:

(1) Sketching: Sketches can be photos of drawings made with paper and pencil, screenshots from existing interfaces, images of objects or anything else that can be captured with a camera and seems meaningful to the UI designer. All sketches are stored in a repository on the *Wizard's* device. Whenever a selection is made by the *Wizard* the corresponding sketch is displayed on the *participant's* device immediately as the current UI screen. In addition, Internet access serves as an additional resource for relevant information, data and media items to respond to the *participant's* input *in-situ*.

(2) Enriching: We call the process of augmenting the sketch with interactive elements like sensor data or multimedia elements *enriching.* To this end, the *Wizard's* UI is split into sections (see illustration in Figure 3).

The current screen of the *participant's* device is displayed on the very left (i.e., 'what the *participant* sees'). The remainder of the screen provides either 1) an overview of sensor readings transmitted by the *participant's* device 2) an overview of all available sketches/photos/actions/ *intents* 3) an Internet browser. The prototype is enriched by two ways. First, sensor data describe the state of the *participant's* device. Second, the *Wizard* can trigger actuators (e.g., vibration alerts) or build-in apps (e.g., the camera app/*intent*) on the *participant' s* device remotely.

Combining the generic components described above with paper-prototypes and Wizard of Oz techniques exposes the *participant* to the experience of an interactive prototype without the need for the researcher of implementing such functionalities. Augmenting *FamOz* with elements such as pop-up dialogs or input boxes can be obtained easily by utilizing *intents*.

We go on to briefly describe three fictitious scenarios for further illustrating how *FamOz* can be used in the initial exploration of novel mobile apps in different 'real-world' settings. Each scenario features highly interactive applications that are 'mimicked' by the *Wizard* applying *FamOz*.

SCENARIOS

(1) The Co-Design of an app to help patients lose weight: A mobile app assists patients in controlling their diet by logging their health behavior (diet). The patient (participant) is allowed to eat only specific food products, but is not experienced in recording daily routine activities. The *participant* starts the app 'in the wild' (at home) and, for example, takes a photo of some specific food. The photo is automatically transmitted to the

Wizard's device. The *Wizard* analyzes the content of the photo and sends a corresponding recommendation back to the *participant's* phone, for instance, approval or disapproval of this particular meal. The *participant* again can respond to the information, for example, asking a question via texting, whereas the *Wizard* can offer their answer spontaneously in return. If certain elements of the UI are missing, designers can draw or create new sketches 'on the fly' and integrate them into the prototype application. The sequences of this co-design process are automatically recorded (including interactions with sensors). Eventually, these recorded sequences can aid the designers in analyzing and finalizing their concept.

(2) In-situ testing of an explorative travel app for tourists: The *participant* 'hits the road' as pre-defined by the *Wizard* and their location is transferred and recorded by *FamOz.* On request, the *Wizard* sends data, that is, when the *participant* takes a photo of a building and is demanding further information. Each time something remarkable happens (e.g., passing by musicians on the street), the *Wizard* pushes a notification inviting to explore a function of the app (e.g., "Do you want to determine your GPS location and upload a photo of the musicians to your map?"). This leads to the exploration of new serendipitous ways for route planning and leisure time.

(3) Disruptive explorations: Despites being a common design method, disruptive exploration is rarely used in mobile design. Due to the ability of *FamOz* to react to the *participants'* input *in-situ*, contextually surprising or irritating responses from the *Wizard* can provoke interesting participant reactions and thus enable new insights into given contexts. Areas of applications comprise, for instance, testing negative scenarios of data protection, privacy and the like.

FUTURE WORK

In this paper we presented the concept of the *FamOz* prototyping tool, implemented for Android. One reason for employing Android is its *intent* mechanism that offers a feasible way for accessing built-in components such as the camera, text input or various sensors. Such *intents* enrich low-fi prototypes with high-fi interactivity and allow studying real-world interaction *in-situ* at low cost. *FamOz* has the potential for empowering non-programmers (e.g., usability experts or non-expert *participants)* to take part in the creation of novel concepts for the mobile domain. Offering intuitive tools for the creation of sensor-rich mobile prototypes can broaden the use space for such applications even more.

FamOz sets itself apart from existing prototyping tools by allowing the *Wizard* to interact with the *participant in-situ* without the need for additional software and hardware. This *all-in-one* approach showed promising results in initial user tests, however, it raises three research questions for future work: (1) How will the *Wizard* cope with the constraints of mobile devices? (2) How will the *Wizard* handle the cognitive load involved in mimicking the system's logic? (3) How will the *participant* deal with possible delays when waiting for responses?

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