# Evaluation of Camera Phone Based Interaction to Access Information Related to Posters

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## ABSTRACT

In our daily life we are surrounded by posters advertising brands, products, and events. Seeing an interesting poster we often want to access related digital information and services, such as a ticket service, reviews, and opening hours. The easiest solution today is to open a browser and type in the URL printed on the poster or use a search engine to find related content. In this paper we present a system that enables the user to shoot a photo of a poster using a mobile phone. The photo is analyzed and the user receives related information and services. We compare this interaction technique with the facility provided by recent PDAs. Our evaluation with 46 participants shows that the designed interaction outperforms a virtual keyboard based interaction in terms of speed and user satisfaction.

## 1. INTRODUCTION

Mobile devices such as mobile phones and PDAs are a part of our daily life. Ubiquitous Internet access has made it possible to access almost any digital service as for example, ticketing, reviews of scientific publications, and checking opening hours while on the move. So called Out-of-Home advertisements, in particular posters, often promote products and services. To access promoted services and check background information, either an Internet search engine has to be operated or a URL printed on the poster has to be entered using the mobile device. Due to the limited input capabilities (e.g. virtual keyboards or multi-tap) provided by today's mobile devices this is typically an annoying task.

Our aim is to provide mobile users with information about advertised products and related services more conveniently. In order to do that we developed a system based on a point-and-shoot metaphor using content based image analysis to recognize photographed posters and provide according information and services. It enables users to shoot a photo of a poster using a mobile phone's camera and receiving according information. We conducted an evaluation to compare this interaction technique with virtual keyboard based interaction provided by recent PDAs. We asked participants to answer questions by accessing digital information related to posters with both interaction techniques. The goal was to find out if the camera-based interaction technique allows faster and more convenient access to the related information.

The remainder of this section analyses advertisement posters and the design of the developed system. Section 2 reviews the related work while Section 3 describes our evaluation and its results. Section 4 presents our conclusion and future work.

### 1.1 Advertisement Posters

Posters are used to advertise brands, products, and events. They are an unobtrusive way to convey a message to mobile people. We assume that companies advertising products or brands usually want potential customers to access their website. To prove this assumption we performed a preliminary study analysing advertisement posters of Ströer Media[1], Germany's largest marketer of so called Out-of-Home media in Germany. URLs printed on the poster can be used as an indicator for a company's desire to lead persons to the respective web site. To find the fraction of posters containing a URL we analyzed 500 randomly chosen advertisement posters produced in 2007. These City-Light-Posters ($2m^2$ format with backlight usually found in busy streets and large squares) were supplied by Ströer.

We found three categories concerning the presence and appearance of URLs on posters. On 12% the URL was a dominant part of the posters, 56% contained a clearly visible URL that was not a dominant attribute of the poster, and 32% contained either no or a very small URL. Figure

[1]Ströer Out-of-Home Media AG - http://www.stroeer.de


(a) (b) (c)

**Figure 1: Three typical advertisement posters. (a) The product's URL is a dominat part of the poster, (b) the URL is clearly visible, and (c) no URL is shown on the poster.**

1 shows an example of each category. Most of the posters without a URL advertised a very strong brand or addressed a regional audience. Because of the high number of posters containing a URL we conclude that companies often want to guide potential customers to their web page.

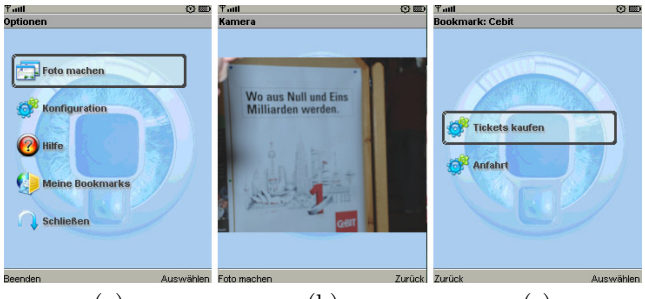
## 1.2 Design of the System

To provide mobile users with information about advertised products and related services more conveniently, a system was developed that enables to access services related to posters using content based image analysis. The development followed an approach that addresses a wide spectrum of real world objects [3]. The concrete instantiation of the system consists of three components: Posters that we consider as a specific type of real world objects, a mobile camera phone that provides a visual user interface, and a server application that stores descriptions and related services for posters.

The mobile phone centralizes the interaction between the user and the system. The user creates a photo of a poster with the application. This photo is transmitted to a server application that compares it with images of posters stored in a media repository. For this comparison Scale Invariant Local Features (SIFT) [5] keypoints are extracted from the photo as well as from the poster images. The SIFT keypoints are compared pairwise and the poster with the highest number of matching keypoints is considered as the photographed poster. For each poster, descriptions of related services consisting of a category (e.g. ticketing service, background information, and opening time), a name, and an according URL are stored in conjunction with the respective poster. The description of the poster with the highest number of matches is transmitted back to the mobile phone. On the phone the services are presented to the user. Selecting a service the user is guided to an according web page. Three screenshots of the mobile application are shown in Figure 2.

# 2. RELATED WORK

With commercially available smartphones the Internet browser can be used to access information about events or products advertised by posters. Recent mobile devices provide different interaction techniques to access information via the Internet. Users must either enter a URL or use a search engine to find the information. Few devices provide a full keyboard that allows entering URLs or keywords. On mobile phones the key-to-letter mapping technique that requires tapping a key multiple times for most letters is commonly used. Another prevalent technique is based on virtual keyboards on touch-screen devices. A pen or the finger is used to press the keys of the virtual keyboard.




(a) (b) (c)

**Figure 2: Screenshots of the mobile application. (a) Application's main menu, (b) view to select a photo by taking an image, (c) links to two services are provided**

More sophisticated approaches to access information related to real world objects have been proposed. Fitzmaurice was one of the first who described the vision of using a mobile device for pointing based interactions with remote objects [2]. In the last decade more and more approaches to facilitate interactions with objects in the real world have been suggested and developed. Existing solutions that can be used to access digital services connected with posters are either based on the recognition of electronic tags or visual codes. In addition, content based image analysis has been proposed as a solution to find the link between objects and related services.

Pohjanheimo et al. realize a physical browsing concept using an RFID-reader [6]. The user touches a RFID equipped area and gains access to related services. A similar system that allows touching RFID equipped visual symbols to activate services was developed by Riekki et al. [8]. Rukzio et al. developed a framework that combines different technologies, such as RFID, visual marker recognition, and Near Field Communication (NFC) [11].

Rekimoto and Ayatsuka developed Cybercode [7] using 2D-barcodes to tag objects for augmented reality. One of the described applications is using a mobile phone to recognize the 2D-barcodes. The user points the mobile phone's camera at a 2D-barcode and receives an encoded URL that links to further information. Rohs developed a similar system [9] and derived requirements for the design of suitable barcodes [10]. QR Code [12] is a standardized 2D barcode format that can contain a URL linking to further information. QR Codes are, for example, printed on posters or newspapers. Some mobile phone companies, especially in Asian countries ship their phones with software that recognizes QR Codes.

Another approach is using digital photos of objects to find the corresponding digital information using content based analysis. Liu et al. use the camera of a mobile phone to select documents displayed on computer screens [4]. Erol and Hull use mobile phone's cameras to enable the user to select presentations slides using photos of the slides [1]. In our previous work we developed a system to access services related to posters and public displays using image and context analysis [3].

Equipping Posters with short range electronic tags makes it necessary to touch the tag with a reader. Thus, users must approach the poster which is not always possible because the posters might be out of reach. Furthermore, posters must be equipped with a huge number of tags if additional visual signs should be avoided. Long range electronic tags would not solve the problem, since then the user's device is not able to decide on its own which object the user wants to select if multiple posters are set up. In contrast to electronic markers visual tags can be identified unambiguously from nearby to far distance if they are large enough. However, it can be assumed that especially for advertisers it is important that the visual appeal of advertisement posters remains unaffected. On one hand the marker must be big enough to be recognizable over a distance but on the other hand should

not displace the real content of the poster. Content based approaches do neither require to add technical equipment to the poster nor to alter its visual appearance. Still, objects can be recognized from near to far distances. Thus, content based approaches seem to be best suited for advertisement posters.

# 3. EVALUATION

We conducted an evaluation to compare the developed system that implements the camera-based interaction technique with an established interaction technique provided by recent PDAs. In the experiment, users had to access information related to advertisement posters using both interaction techniques. Our assumption was that the camera-based technique is faster and easier to use than interaction techniques provided by today's devices.

As shown in Section 1.1 the majority of posters contain a URL. Thus, we decided to let participants enter URLs directly and not use a search engine. We chose to use the virtual keyboard since we assume that it is better suited for entering URLs than other input techniques, such as key to letter mapping.

## 3.1 Method

*Design.*

The interaction technique is the experiment's independent variable. Every participant used both techniques in random order to avoid sequence effects. As dependant variable we recorded the time it took the participants to answer a question related to the content promoted by a poster. Participants provided information and subjective impressions using questionnaires. In addition, we asked to rate the interaction techniques on a five point Likert scale.

*Apparatus.*

The apparatus consists of three advertisement posters, two Nokia N95 mobile phones, two Glofiish PDAs, a laptop, and a WLAN access point. Each of the three different advertisement posters contained a clearly visible URL. Content optimized for mobile Internet browsers was prepared for all posters.

The server described in Section 1.2 was used on the laptop.

(a) (b)

**Figure 3: (a) User entering URL on a PDA; (b) User shoots a photo of a poster.**

**Figure 4: Evaluation booth at the student cafeteria of the University of Oldenburg.**

The laptop also served as a web server to provide web pages related to the posters. An additional DNS server on the laptop allowed entering standard URLs (e.g. cebit.com) to access the prepared web pages. The WLAN access point was connected to the laptop to ensure reliable wireless network access for the mobile devices.

The client application was installed on the Nokia N95s (see Figure 3 b). Participants took photos of the posters using the integrated high resolution camera. According to the server's response the Nokia N95 displays a list containing five web-links to information related to the respective poster. For our control condition we used a Glofiish X500+ PDA (see Figure 3 a) with virtual keyboard running Windows Mobile 2005. Entering a URL printed on a poster in the integrated web-browser the web-server returned an according web-page containing links to the same pages used for the mobile phone.

*Procedure.*

We set up the evaluation booth at the student cafeteria of the University of Oldenburg (see figure 4). The study was conducted on a Monday from 11.00 to 15.00. People were randomly asked to participate in the study. After a person had agreed to participate in the evaluation, the experimenter made the participants familiar with the posters and outlined that he or she had to answer questions regarding the events advertised by the posters.

Each interaction technique was introduced to the participants before starting the experiment. Both devices were handed out with the relevant application running. After the interaction technique for the first run was chosen the participants were asked to answer a question regarding one of the promoted events (e.g. "What are the opening hours of the CeBIT?"). A stop watch was started right after the device was handed out and the question was asked. When the participant gave the answer, the stop watch was stopped and the time was noted. Then the participant switched to the other interaction technique and the procedure was repeated, with a different question relating to another event. Afterwards, the participants were handed out the questionnaires, where they could rate both interaction techniques. The Glofiish's

browser cache was deleted after each participant, so the successor had to re-enter the URLs in full length.

*Participants.*

46 people (23 female) participated in the evaluation. Most of them were students of the University of Oldenburg. They were 20-50 years old (M=25.16, SD = 5.67). 93.3% of the participants owned a mobile phone where 92.9% of these phones are equipped with a camera. 57.8% of the participants have at least once installed an application on a mobile phone.

## 3.2 Results and Discussion

The average time to answer the given question was 52.81s with a standard deviation (SD) of 20.88 using the camera based interaction technique and 64.88s with a SD of 25.08 using the virtual keyboard. The camera based interaction technique had a significant but small effect on reducing the response time ($t(41) = -2.60$, $p < .01$, $r = .16$). The difficulty of using the interaction techniques was rated on a five point Likert scale, where 0 meant very easy and 4 meant very difficult. Participants found the point and shoot interaction technique easier to use (Mdn = 1) than the virtual keyboard (Mdn = 1.5). A Wilcoxon test revealed a significant large effect on the perceived difficulty ($T = 724, p < .001, r = 0.61$). 63.04% of the participants could think of using the phone based application and 50% the PDA based technique in their daily life. Only 4.4% were willing to pay money for the presented camera based service, 37.8% might be willing to pay, and 57.8% negate to pay.

The main result of the evaluation is that the developed camera based access to information related to posters is significantly faster and found significantly easier to use. However, the effect on the response time was statistically small. We argue that this finding is still substantial, since the non-clinical setup added lots of variance to the experiment. For example, participants were not patient enough for a longer training session, so all of them were untrained. Participants also spent a good part of their time browsing the web-pages themselves rather then performing the interaction for accessing them. We expect that a lab study just comparing both interaction techniques would reveal a larger effect.

Combining the people that would use the camera based interaction technique and have experience in installing application on the mobile phone as well, 34.8%, about one third of the participants would be potential customers of an application integrating the camera based interaction technique.

# 4. CONCLUSION AND FUTURE WORK

In this paper, we described a camera based interaction technique to access information and services related to advertisement posters. Unlike other approaches content based image analysis is used to determine the physical-digital match. The conducted evaluation with 46 participants compares this interaction technique with a virtual keyboard based input technique provided by recent PDAs. It could be shown that the designed interaction outperforms the virtual keyboard based interaction in terms of speed and user satisfaction. However, the observed variance shows the importance of further investigations. In particular, we assume that our results are affected by the participants' lack of training as well as the time they spent browsing for the right answer.

Besides the refinement of the system based on the evaluation results, we plan an outdoor evaluation in a larger scale. With this evaluation we hope to reduce the observed variance and compare our approach with further interaction techniques. Furthermore, the idea of using content based analysis to access digital information can be extended by further matching techniques to address more types of media and real world situations. Integration with our ongoing work [3] will enable to use one system to access information related to diverse real world objects.

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