DroPicks – A Tool for Collaborative Content Sharing Exploiting Everyday Artefacts

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ABSTRACT. Emergence of social web services like YouTube[1], Flickr[2] etc. is constantly transforming the way we share our lifestyles with family, friends and colleagues. The significance of specific contents can be enhanced if shared with the right person, at right location and time. This paper explores this contextual social content sharing mechanism and presents DroPicks that utilizes augmented everyday artefacts as containers for digital information. Many everyday artefacts are immobile, which implicitly restricts contents stored to a location. Such indirect, contextual sharing has advantages over direct communication mechanisms (E-mail, SMS, IM...) as it provides the content in correct context, seeking minimal attention. Considering the lightness of social contents, we argue that our approach is appropriate, as it does not seek immediate attention, but rather offers the content in the background.

1 Introduction

One of the direct implications of the convergence of ubiquitous technologies (like proliferation of wireless internet, short-range radio connectivity, high-end personal devices etc.) is the improvement of peoples' social communication. Internet, E-mail, Short Message Service (SMS) and Instant Messaging (IM) are now integral part of our lives through cell phones, PDAs, Internet Terminals, and Laptops. In addition, social Internet services like YouTube [1], Flickr [2] etc. have provided us with the opportunities to share our lifestyles with our families, friends and colleagues in a new and fascinating way. The meaning and utilization of social contents like photos, video clips or messages can be greatly improved if context information is attached to them. For example: Sharing a funny video clip from YouTube in the coffee room's display in the office might have a greater effect than sending it through email to all colleagues. Previous works on so-called "electronic graffiti" like Stick-e Notes [3] or Place-its [4] allow users to leave an electronic message/reminder for themselves or others associating location context, for example: "There is a better Ramen shop three blocks away". Usually these systems depend on a dedicated location repository and network infrastructure available in the interested locations and they do not consider the social applicability of the contents, e.g. with whom the content should be shared and when. In this paper we have explored this particular aspect of sharing ambient information in a contextual manner with our families, friends and colleagues in a timely fashion exploiting sentient artefacts.

Sentient artefacts are everyday artefacts, like a chair, a desk, a door, a cup, etc. augmented with various kinds of sensors and actuators that suit their appearance and

primary functionalities. So far we have utilized these augmented artefacts e.g. as context providers or for providing ambient feedback [5, 6, 7, 8]. An interesting property of some of the everyday artefacts is their binding to a specific location. For example, a meeting table in the office room or a refrigerator in the coffee room etc. These artefacts are suitable as a container for containing indirect content sharing, eliminating the requirement of any positioning infrastructure. We present DroPicks, a tool that allows sharing social content utilizing sentient artefacts and Internet terminals. User can touch a designated artefact to share content with someone or with a group. Here by content, we mean the metadata that describes an actual content, for example: URL of a video clip. Once the content is dropped to an artefact, it provides ambient clue(s) to the intended persons to pick the content. **Figure 1** below illustrates some use cases of DroPicks.

(a) (b)

Fig. 1. DroPicks in action: At the left user picks up content using internet terminal and augmented desk in his personal space while. In the next photo he leaves something behind to a common area augmented display.

DroPicks makes it easy to share contents and has advantage over direct communications like SMS, IM and E-Mail because of its contextual location-centric sharing characteristics. In addition, DroPicks offers the contents in the background unobtrusively, offering the content to only interested people, which is not possible with direct communications (There is no way to block a specific SMS or E-mail from trusted senders based on the content priority). Furthermore, DroPicks can be used as a location-aware personal reminder. Our initial user evaluation shows that DroPicks is quite promising, especially because of its intuitive utilization of location specific artefacts. However, there were mixed comments on its overall affectivity over the direct communications. Rest of this short paper is organized as follows: Section 2 summarizes the usage, requirements and design considerations of DroPicks. In section 3 we present the application itself in detail. Following sections, 4 and 5, provide implications with some related work and discussion and conclusions of DroPicks.

2 Use Cases and Design Principles

DroPicks has four use cases. Each of these cases has some requirements that we needed to fulfill while constructing DroPicks application:

Creating a content item from web content requires a comfortable method for acquiring this item from a normal web environment.
"Physical" dropping and picking of a content item needs augmented artefacts which are capable of communicating and storing digital data. Furthermore, a tangible interface between devices and artefacts has to be provided.
Usage of personal reminders with sentient artefact relies on a way to create these reminders easily and artefacts capable of notifying accordingly.
Dedicating the content to an appropriate recipient and remote deployment of content needs support for browsing and selecting from available users and sentient artefacts.

Considering the use cases presented above, we decided three primary design principles to follow in DroPicks:

Simple interaction. To appeal to a user in the first hand, the system must be as pleasurable to use as possible. Besides offering an easy way to create and view content, the system aims to mimic physical drop and pick as closely as possible.

Ambient feedback. In order to be noticed from environment and to increase interaction between users and sentient artefacts, visual and audio based feedback should be provided. When dealing with sentient artefacts, one should somehow feel the difference between a regular artefact and an augmented one.

Privacy enabled sharing of content. The system has to support the sharing of content with the right person in a secure way, i.e. not exposing the content to unintended recipients. We need to support sharing in *one to one* and *one to many* sharing.

3 The DroPicks Application

As shown in **Figure 2**, DroPicks utilizes two components, Internet terminals and Sentient Artefacts:

As the terminals for DroPicks we are using Nokia N770 Internet tablets. Internet tablets are aimed primarily for Internet browsing. We see these devices as a rich and interesting platform for prototype applications because of their relatively cheap price, suitability for fast developing and comfortable user interface.

Sentient Artefacts are augmented everyday artefacts capable of performing additional functionalities beyond their primary role. For example: A mirror can be augmented to act as an ambient display in addition to its primary role of reflecting image. Augmenting everyday artefacts and using them for various ubiquitous computing tasks have been widely discussed and researched in [5, 6, 7, 8]. Many of

these artefacts, e.g. a couch in the living room or a refrigerator in the kitchen, are static in nature and thus associated to a specific location. This particular property gives us an implicit advantage of augmenting these artefacts for location specific services. In DroPicks, we have used sentient artefacts as location specific container for lightweight social communications.

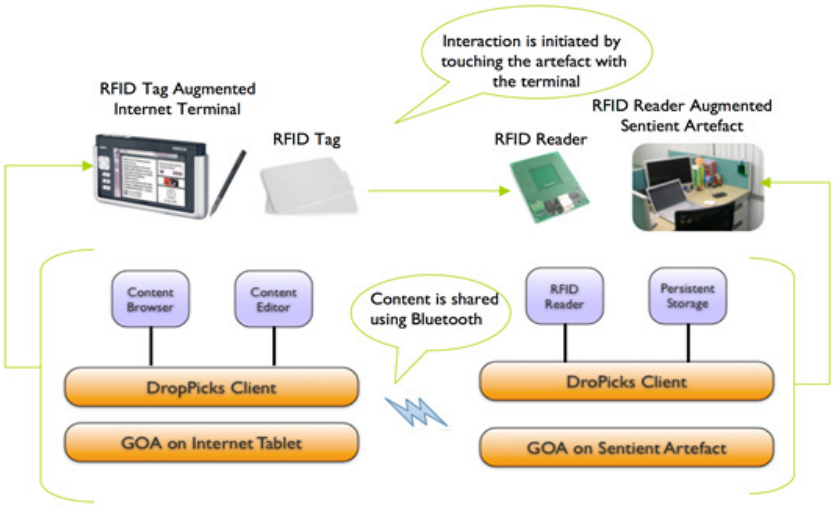

Fig. 2. Architecture of DroPicks. GOA middleware handles group management and RFID is utilized for initiating the Bluetooth communication sequences for sharing contents using internet terminals and augmented artefacts.

DroPicks shares so called *content items*, lightweight data objects that carry metadata with it. The mandatory part of a content item is the recipient specification; either whole group of a single member of a group. An item can contain URL(s), recipient, human readable name, a free description and some tags, i.e. keywords describing its content. Besides this, content item can also consist of a simple timed calendar note with a message. If nobody picks the content for a time specified by the host artefact, it will be deleted automatically. Also, the artefact can specify a pick limit for an item. After being picked stipulated times, it is automatically deleted.

In order to support simple interaction, DroPicks provides a status bar icon for the user interface of N770 device (**Figure 3**). This way, when user is browsing the web and finds an interesting page, he only has to copy the address and click the icon. Immediately, a pop up window is provided to choose the receiver and provide further information if desired. Clicking ok finishes the item creation. For providing a tangible interface we utilize RFID technology. This method has been researched and found to be an effective and convenient way to access various services in the environment in e.g. [9]. RFID is used to trigger the interaction between internet terminal and the artefact while the actual communication, handshaking, negotiating on the device mode (drop/pick) etc. is done through Bluetooth. We have avoided Bluetooth for triggering purpose due to time-consuming discovery phase. The model is described in detail in [10]. Items picked get stored automatically in the local device, thus giving

the user a firm choice of viewing the item right away or just collecting it for later usage.

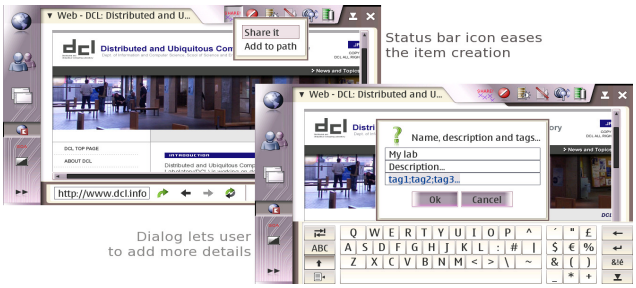

Fig. 3. After the web address is copied, user presses the status bar icon. A pop up window is launched to allow adding some details to the content item being created. After finishing, the terminal is in drop mode and ready to deploy the just created item.

DroPicks provides ambient feedback to make the user feel and note the interaction with the environment. This is supported by the sentient artefacts. They are capable of playing sounds when an item is dropped or picked. Depending to the artefact, it can also be equipped with different LED kits and lighting capabilities as well. When something is available, it can blink or provide softer visual clue about the content.

In DroPicks content items are shared for one or many recipients that belong to the same group of content creator (**Figure 4**). Identifying users and managing the groups in the environment is enabled by a simple middleware called GOA. It handles all user related managing as well as privacy by handshaking and recognizing the users. Both the internet terminal and the sentient artefacts run GOA. When dropping or submitting an artefact, it contains recipient information. After the device makes a request, artefact returns an item if the requestor is allowed to obtain it. Each user of the systems has a unique identifier which is generated the first time they run GOA.

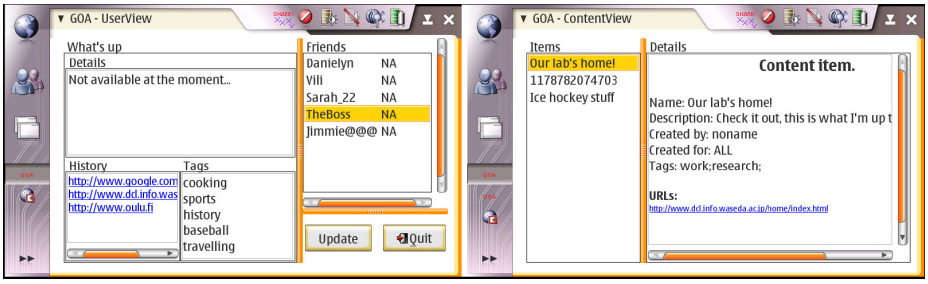

Fig. 4. User interfaces of DroPicks: views for displaying group environment and local content items. Through UI the user can e.g. create, delete, drop and edit items.

4 Implications

We performed an informal user trial with 10 participants aging from 25 to 29, all of them technical students and thus capable of understanding new technologies and systems and providing valid feedback. After introducing and demonstrating DroPicks, we let the users create and share contents freely.

In general, DroPicks got quite a deviated response. Definitely the main concern noticed was the difficulty to understand the overall concept of using sentient artefacts as digital memo boxes. Many of the testers misunderstood it or did not see the difference to instant messaging, e-mail and similar already available communication ways. The user interface issue seemed to rise also often. The internet tablet itself and DroPicks did not offer as convenient way to browse and create content as we hoped it would do. Users were already accustomised with their PCs or mobile phones which they use everyday for communications.

Users proposed that we should provide support for full synchronization with sentient artefacts and sharing full content instead of a URL. Also there was seen a need for categorizing the content stored. DroPicks was considered a useful system when dealing with privacy restricted use cases. It allows deploying personal memos in a public space. The system would also be free to use, since there wouldn't be any data packet costs over a commercial network. Avoiding physical notes and paper was considered a good thing also. Linking the digital content with physical artefacts was also an interesting and fresh functional aspect to testers.

Some of the ideas of DroPicks have been researched before. NuggetMine [11] is very similar to our concept of sharing metadata among group members. They provide a visual interface centered on desktops to share and browse small self-contained information among the group members utilizing a central server. DroPicks supports mobility and is independent of any centralized repository. In addition DroPicks' background appearance makes it more suitable for social contents. Forget-me-not [12] and Place-Its [4] are two of the earlier efforts to support location aware personal reminders. Stick-e Notes [3] project is perhaps the closest to our approach of tagging artefacts with digital notes as it explored the post-it metaphor as digital world rather than real world using GPS enabled PDA. DroPicks differs from these by being independent of any location-sensing infrastructure and utilizing only augmented artefacts for associating content with location, thus eliminating e.g. the need for GPS. However, DroPicks only works in Indoor facility unlike the above systems where coverage is broader.

5 Discussion and Conclusions

In the following, we discuss about characteristics of combining sentient artefacts and groupware into DroPicks and draw conclusions of the research done. Also limitations of DroPicks are addressed.

Privacy is one of the major concerns when considering notes, memos or any content. Take e.g. a post-it note: you cannot leave a personal message to someone's desk. With DroPicks we support personal messages which are tied to a location and context. When connection is established between the terminal and the artefact, the first thing

done is handshaking where the identities of the participants are confirmed, thus enabling targeting the items.

Location restricted content sharing is introduced by utilizing sentient artefacts. Using sentient artefacts as location restricting element is not only highly accurate, but provides new and different kind of context information. The characteristics of each artefact can tell something about the type of content stored in it. Consider a normal household for example. With current technology it is possible to recognize someone's location in the house and build services accordingly as proven in many research projects. Sentient artefacts, on the other hand, make it possible to go a step further. They allow us to associate appropriate content with appropriate items with similar association or role. Content item stored on someone's workspace is most likely different by its nature than the one stored in a fridge or a night desk. Over time, a possible situation would be that certain type of content would find own home among our everyday objects in our house. It isn't hard to imagine a common area in a student dormitory equipped with augmented artefacts. People visiting there could share favorite entertainment online by leaving content items on the couch or shelf. This offers us the benefit of targeting the content to a narrower target group and reducing the overhead of sharing content to a group. Compare e.g. to posting an e-mail to whole company's e-mail list, out of which maybe only a fraction is interested in it.

Despite successfully working in our test environment, DroPicks realizes some limitations. As a pure P2P system, DroPicks does not have a centralized server or infrastructure to support functionality among different networks. Thus, it has to be run in the same network in order to e.g. support discovery of remote artefacts. Also, since DroPicks runs on Internet terminals, not all the advanced web functionalities are available. Furthermore, DroPicks depends on sentient artefacts which are primarily nonexistent in domestic environment.

We presented DroPicks, a sophisticated tool that utilizes groupware and sentient artefacts for sharing content in a collaborative environment. DroPicks shares content items that are designated for one or more recipients. We did not aim to share heavyweight content, but rather metadata or a personal memo. With the help of sentient artefacts, we achieved accurate location and contextual restriction for our content sharing scheme.

An informal user study was performed to gather feedback and ideas on the overall concept. We learned that the system's purpose was quite hard to understand, and it was hard to differentiate DroPicks from instant messaging or e-mail communication. Also, the interface was recognized to be somewhat too clumsy. However, many positive things could be found in DroPicks, such as using it when privacy is an issue and the nonexistent usage costs. It avoids the usage of physical memos and allows the user to narrow the target audience by the means of location restriction and utilizing sentient artefacts.

We have a lot of ideas and suggestions for improvement of DroPicks. Another aspect that we are investigating is the expressiveness of an artefact, i.e. how an artefact can be understood to have such storage features by the end users? We hope to address this and improve the system beyond current limitations in the future.

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