Hovering: Visualising RFID Hyperlinks in a Mobile Phone

Pasi Välkkynen
VTT Technical Research Centre of Finland
P.O.Box 1300
33101 Tampere, Finland
+358-20-722 3353
pasi.valkkynen@vtt.fi

ABSTRACT
Physical browsing is a mobile terminal and tag based interaction paradigm for pervasive computing environments. The tags offer to the users physical hyperlinks that can be read with a mobile terminal and that lead to some pervasive services or information. Hovering is an interaction technique, which allows the user to quickly check the contents of a tag by 'hovering' the mobile terminal over the tag. In this paper, I describe a prototype system that implements the hovering concept with a mobile phone and RFID tags. The purpose of the system is to study physical hyperlink visualisations, both in the physical environment, and in the graphical user interface of the mobile terminal.

Categories and Subject Descriptors
H5.2 [**Information interfaces and presentation**]: User interfaces – *input devices and strategies.*

General Terms
Human Factors.

Keywords
RFID, physical browsing, mobile phone, hyperlink, visualisation

1. INTRODUCTION
In physical browsing, the user can access information or services about an object by physically selecting the object itself, for example by touching or pointing to the object. The enabling technology for this is tags that contain the information – for example a Universal Resource Locator (URL) – related to the object to which it is attached. A tagged physical environment can be seen as analogous to a WWW page. It contains *physical hyperlinks* to different services and the user can 'click' these links with a mobile terminal in the same way desktop WWW links can be selected with a mouse.

As links in desktop web, the physical hyperlinks should be visualised to let the user know that 1) there is a link, 2) where it is located, 3) how it can be selected and 4) what will happen after the link is selected. The visualisation can happen in many levels: in the physical object itself the tag may have some icons representing its action and selection method, or the link can be visualised in various ways in the graphical user interface of the mobile terminal.

In this paper, I describe a physical browsing system built on a Nokia 3220 mobile phone. This application enables users to use physical shortcuts to activate digital services in their mobile phone. The purpose of the system is to be a tool for studying user interaction with physical hyperlinks. This system allows similar interaction with links as Nokia's built-in "Service Discovery" application but with extended link visualisation capabilities.

Physical hyperlink visualisation is still a relatively unstudied issue. We have presented some challenges [4] related to the visualisation of the tags. Riekki *et al*. [3] have also studied visualisations of RFID (Radio-frequency Identifier) tags. Generally, physical browsing systems in literature (for example [1], [2] and [5]) do not report in detail their pre-selection visualisations, if they exist. Weinreich & Lamersdorf [6] have implemented a link visualisation system for desktop WWW. Their system takes into account several attributes of a link, for example title, author, language and server response and display them as tooltips when the pointer is hovering over the link.

2. USER INTERACTION
The basic sequence of touch-based mobile interaction with physical hyperlinks is that the user brings the mobile terminal close to the link, after which the terminal reads the contents of the link and displays it to the user. In hovering, the user can 'hover' the mobile terminal over a link similarly to how hovering works in desktop web. In desktop web browser, when the pointer is hovering over a link, additional information about the link is typically displayed. The browser usually displays the address the link leads to in the status bar and if the link has a title, it is displayed as a tooltip next to the link. In this mobile phone based hovering, the link information is displayed in the mobile phone screen before the link is actually selected and activated. This way the user can quickly check the contents of several links before actually selecting any of them (Figure 1).

Figure 1. The user is checking what links the business card contains.

Hovering differs from confirmation dialogs ("Do you want to go to http://www.foo.com?") by not being a question to be answered. It does not present a modal dialog that has to be answered, instead it quickly displays some information about the link and the user can hover over several links to check each of their contents.

There are two main display modes in the hovering application: single and list (see Figure 2). In the single mode, only one link at a time is displayed but more information is available. In the list mode several links are displayed as a list. In either mode, pressing the Select button will activate the link, for example show the information or make the phone call to the number read from the tag. In the list mode, more information about the link, similarly to the single mode, is displayed when the user chooses to view the link list item in its entirety.

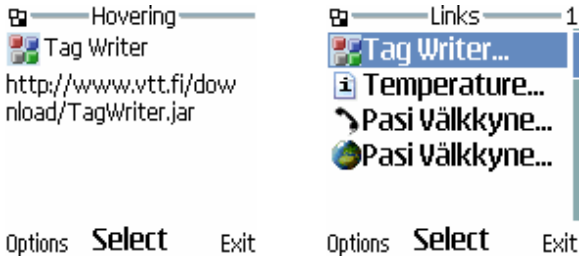

Figure 2. On the left is shown the single link display mode. Only one link is displayed but with more information than in the list mode on the right.

Each link has a title, contents and an icon. The title is a human-readable short description of the link. The contents contain the actual content of the link, for example a web address. The icon gives a graphical cue about the type of the content so that the user does not necessarily have to try to figure it out from the content resource.

As seen in Figure 3, each content type has its own visual icon. The purpose of the icon is to give a quick way to see what the type of the link content is. Additionally, it is intended to help differentiate in the list mode between links that have the same title but different content type. For example, a phone number and a web address might both have as the title the name of the person whose phone number and web address they are, but with different icons they can be quickly told from each other.

Figure 3. Different content types. On the upper row there are visualisations for phone call and local information, and on the lower row remote information and installable application.

All information links were initially visualised as 'i' but with the current mobile network speeds, there is a huge difference with interacting only with local connectivity or with remote services (for example a WWW page). If a link leads to an external communication, it is visualised with a globe symbol in the hovering application and only local services are visualised as 'i'. One reason for the globe symbol is that Nokia 3220 uses the globe icon for web access. This should make it easy to recognise to a user who is used to the phone.

3. SYSTEM

The hovering system is built on Nokia 3220 mobile phone[1] with Nokia's Xpress-on NFC shell. The software platform of the phone is S40[2] that can run Java MIDlets.

NFC[3] records are used to store the data in the tags in different fields. Each tag has a Title field, and a URI field. The Title field is used to display the title of the link in human-readable form and the URI is used to store the content. The content can be a link to a web resource, a telephone number, a link to a JAR file for downloading and installing applications, or a sensor reading.

The sensor reading does not come from a real sensor, instead it is a random number from a suitable range. The purpose of the sensor "mock-up" is to demonstrate to users how mobile phone based interaction with RFID sensors might look and feel.

[1] www.europe.nokia.com/nokia/0,8764,58033,00.html

[2] www.forum.nokia.com/main/0,6566,010_200,00.html

[3] www.nfc-forum.org

The icon is determined from the content of the URI field in the tag. The content type could be checked by querying the web server (in case of WWW resources) but that would take a considerable amount of time with current cellular connection. And after all, the purpose of the system is to be a tool for visualisation studies instead of a physical browsing system that implements all possible security features. I have chosen the same approach as in desktop WWW browsers: the user is given the link title and if he or she can understand how URLs work, the address can also be investigated.

4. CONCLUSION

Optimally the links are visualised also in the physical objects, so that the user can know how to select the link and what action it contains. Hovering can help 1) visualise the action if only selection technology is visualised in the tag (for example NFC symbol), and 2) give additional information about the link such as the actual URL.

The future work on this concept will include building some tagged environments and evaluating the concept with users. Some questions in the evaluation will be the general usefulness of hovering, which display mode (single or list) is more useful and what information the user needs to see about the link. The intention is to study how hovering works with physical visualisations on the tags and how best combine these two visualisation techniques. The current prototype will also be extended to allow interaction with more types of contents, for example SMS messages and tags that can set some context information for the phone.

5. REFERENCES

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