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PDA's as mobile WWW browsers

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Abstract

In this paper we present a WWW frontend for Apple's Personal Digital Assistant (PDA) Newton. At the Telecooperation Office (TecO) we carry out a project researching information retrieval by mobile hand-held devices. In this context we are investigating impacts of PDA architecture (e.g. limited storage capabilities, small display) on the usability of these devices to act as WWW browsers. As a result of these activities, we developed a WWW browser for the Apple Newton PDA. Currently WWW access is restricted to stationary hosts. It would be a very promising approach to have access to this global information system via mobile devices. PDAs are the pinnacle of modern computer and communication technology and supposed to be in everybody's possession in a few years. These hand-held systems offer wireless communication and advanced integration: You can carry computer and communication services in your pocket. They can be used as mobile information browsers not only in hospitals or libraries but also in future offices and everyday life where all kind of information access are to be combined in one device. We demonstrate the feasibility of providing access to WWW via mobile hand-held devices. Based on our experiences we will report the special requirements for PDAs as WWW clients. Those requirements are, e.g., pre-processing of graphical data and reflection of small bandwidth wireless communication. We will present the architecture of our PDA WWW browser based on the concept of distributed clients and discuss desirable PDA specific features of the WWW service. Finally we want to present first experiences in using the browser and give an outlook on future developments.

Keywords: Ubiquity; Mobile computing; PDA (Personal Digital Assistant); User interface; Wireless; WWW; Information service; Netservice; Bandwidth; Client server; Multimedia; Apple Newton; HTML; HTTP; Browser

1. Introduction

This article focusses on the usability of a combination of existing PDAs, the PDA from Apple with the World Wide Web (WWW) as an online global multimedia information network [4].

At the moment there is a wide range of different pen based computer systems like notebooks,

penboards, palmtops and PDAs. In 1992 Apple's vice president John Sculley used the term PDA the first time to announce the PDA. His PDA combined functions of an organizer (notepad, addressbook, calendar) with communication abilities (fax, modem, e-mail, beam) and an integrated intelligent assistant for less than \$300. Because of the low price, sooner or later everyone will own a PDA. Sculley's PDA was as small as a pocket book, so that every user could operate it comfortable in one hand while standing, sitting or walking around. Its user interface is simple and easy

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to understand for everyone. PDAs lack a keyboard, the pen is used to write notes or to operate programs. Users just write on the screen and the integrated OCR software decodes the input.

PDAs are ideally suited for Mark Weiser's [1] vision of ubiquitous computing. When high speed ISDN networks and wireless modems will be available by the end of the year, everyone can access information services like the WWW from "everywhere at any time".

In his book "Hitchhiker's Guide to Galaxy" Douglas Adams provides Ford Perfect, one of his main characters, with a special electronic travel guide produced by the Ursa minor publishing company. Whenever Ford Perfect needs some information he just types in a keyword and gets all the desired data. Sometimes even more. The combination of a PDA and global multimedia information services is almost the same. Actually it is more!

The WWW supports the user with a wide variety of databases, allows computer aided learning and publishing with text, pictures, sound and short movie sequences and includes online documentation. Its services are directed to students (campus wide information systems), scientists (literature search, access to newest information) and all kind of people who need online information. Other abilities are virtual malls, weather forecast, medical databases, virtual libraries, virtual exhibitions, online dictionaries and so on.

But till these services are only accessible with a host connected to the internet. With a PDA and a wireless modem you could use these facilities no matter where you are at any time!

2. Global information service combined with PDA

To get an impression of the usability of PDAs as common WWW browser some situations are presented:

Virtual library: Imagine someone wants to perform an article research in a conventional library. He has to go to the library, browse several databases and in a first step get some hits. In a second step he takes that list to the

archive and tries to find the articles in the magazines. If he doesn't find one, he has to order it which will take several weeks. With a WWW client on a PDA this process is totally different. The user can perform a search with his PDA anytime from everywhere: On his way to work, in a boring class or during lunch. He immediately gets the hits and can decide which articles he would like. With a simple tap of the pen on the screen of his PDA he can download all desired documents. This all takes him less than 10 minutes for the same amount of information, but this time he was much more efficient. (URL: <http://glimpse.cs.arizona.edu:1994/bib/>)

Travel guide: No matter where the user is, he just switches on his PDA and gets online, error-free information about the place where he is, gets recommendation to restaurants, movie theaters and other entertainment and even gets translations from sentences or words into any language with his fingertips and without carrying tons of books with him. The user would also be able to take a look at his flight schedule, change or book flights or get the latest news from at home. (dictionary: <http://www.leo.org/cgi-bin/dict-search>, travel guide: <http://www.willamette.edu/pgg/>)

2.1. General vision

Like we saw everybody who needs some kind of information when he is not sitting in front of his terminal will highly enjoy the possibilities he has with a combination from a PDA and online information services.

With a combination of a PDA and a multimedia information service like the WWW this visions can be realized today. It would be possible for users to carry "their" WWW with them wherever they go—like they wear their watch wherever they go. And accessing the Web would almost be as easy as checking the time. Due to the high dissemination PDAs will have reached soon, the number of users accessing the net will highly increase.

3. The WWW

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3.1. Possible

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Fig. 1. Possi terminal vs. v

3. The WWW browser

Our primary goal was to develop a tool for ubiquitous computing. There are a variety of parameters like direct vs. indirect connection or terminal vs. workstation functionality of the PDA. In this section we will discuss different architecture designs and present our solution.

3.1. Possible architectures

Unfortunately it is not possible to establish a direct connection from a PDA to the web because WWW-servers aren't accessible by phone by now.

Another possibility is to split the WWW client into two parts, one is the PDA, the second part is a workstation connected to the internet. In this case you can either use the PDA as dumb client (only as a terminal), just sending requests to the workstation and receiving preprocessed PDA usable pages and images from the workstation (see lower part of Fig. 1). This version is definitely the fastest, but the PDA client would depend on one, always the same, workstation. If you are far away from your dedicated host, the phonebill would explode.

On the other a more ubiquitous version can be realized using the workstation to only perform connectivity and let the PDA do the rest (see top of Fig. 1). All WWW hosts should have a WWW-PDA daemon, similar to the finger-daemon. The PDA then can connect to any host connected to

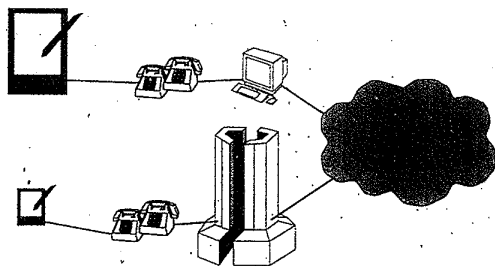


Fig. 1. Possible architectures of the PDA-WWW browser: terminal vs. workstation.

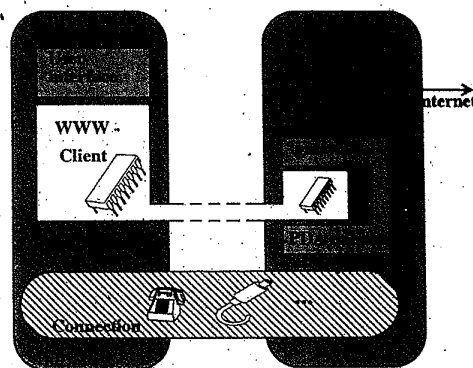


Fig. 2. Distributed WWW-client.

the internet and the telephone using the WWW-PDA daemon and request documents.

3.2. Current design of the WWW browser architecture

Our approach was to offer a ubiquitous system for information access. So our architecture is designed to perform all client-functionality by the PDA.

Because of some lacks in current hardware capabilities (e.g. small storage) and because of some missing features in the HTTP-protocol (next section) there are still some preprocessings to be done by the host.

Our current implementation represents a mixture of the last two architecture versions described in Section 3.1. But this design of a distributed client (see Fig. 2) can easily be extended to a stand alone WWW client as soon as some planned HTTP-features are available and as soon as hardware capabilities of the PDA improve.

The workstation part of the client actually performs the communication with the Web, caches received documents, transforms images into a PDA usable form and manages the breakdown of large text documents into small parts which are sent to the PDA piece by piece.

The PDA part of the client is the dominant part. It already has to perform most of the required features. It manages the whole interaction

with the user, sends its requests to the UNIX-server, receives texts and images, interprets HTML and prints the documents on its screen. Note: the html-interpretation is done by the PDA.

You're able to build up a hotlist as well as all kind of user preferences dealing with the display style. The user interface is designed to have the same look and feel as the well-known Mosaic client. Figs. 3 and 4 show a screenshot from our WWW-client. To follow links in our browser you just tap on underlined words.

3.3. Connection

Actually you can choose between a telephone or a serial connection to the workstation. Both connections offer a bandwidth of only 9600 kbit/s. The phone connection can be used outside your domain to have WWW access from everywhere. The serial LAN connection is in case if sometimes a wireless LAN access is available. So you can build

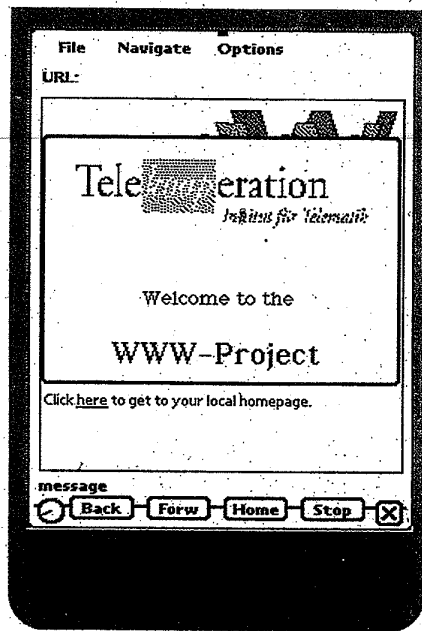


Fig. 3. The PDA WWW browser.

up an inhouse service without any costs for a phoneline. If you use the appletalk protocol, the data transmission will speed up. The serial connection can also be used if a direct internet access is available.

In addition to the printing facility we also support PDA specific communications like faxing and beaming.

3.4. Supported datatypes

Actually our WWW-client for PDAs supports only text and image data. For the special size and capabilities of the display we had to solve different problems.

Text: The LCD-display is small compared to a conventional computer screen. So you have to scroll the text much more often and it might be more difficult to get an overview of the text. One of the design issues for WWW browsers is the ability of producing 80 column text which is not possible with a PDA. So we had two possibilities:

- Four-way-scrolling to present the reader an 80 column text, but it is very annoying to scroll the display in each line of the text you read.
- Two-way-scrolling (only up and down) and only 50 column text. This requires new clipping of the text which sometimes leads to less beautiful results but is much easier to read than possibility 1 (see Fig. 4).

We think the second possibility is much more comfortable for the user. We also tried to "fix" strange clipping by transforming all kind of nested lists into lists of depth one. Titles can appear clipped and using more than one line.

The PDA doesn't support fixed pitch so we couldn't support it in our browser. Text which should be rendered in a teletype font is printed with a proportional font. Long text documents are splitted into small parts by our separate UNIX server and sent to the PDA piece by piece on demand.

We support HTML or plain text. Other browsers are also able to display Postscript files or all kinds of different images by using external viewers which we can't do by now due to low storage capabilities.

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