

Multimedia Client Implementation on Personal Digital Assistants

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Abstract. Their small size and ease of use makes Personal Digital Assistants (PDAs) very attractive for inclusion as clients in mobile multimedia applications. Alas, the cost for integration of PDA in distributed multimedia systems is high, as the resource limitations on PDA require client adaptation, and as software development on PDA is comparatively expensive. We present PocketWeb, a tool facilitating PDA integration in multimedia applications based on the web protocols while freeing application developers from PDA specific software development. We have applied PocketWeb for integration of PDA as multimedia clients in MILLION, a distributed multimedia system developed in an ESPRIT project.

Keywords. Multimedia Client, Personal Digital Assistant (PDA), Mobile Computing, Mobile Multimedia Applications, Multimedia Software Development.

1 Introduction

The new generation of small computing devices such as the Apple Newton MessagePad, the US Robotics Pilot or the Psion Series 3c are currently primarily used in personal stand-alone applications, for example as electronic filofaxes. Now, their small size and ease of use also renders them attractive and potentially useful as clients in networked applications in mobile environments. In fact, a range of applications have already been reported, demonstrating the useful integration of Personal Digital Assistants (PDA) in networked applications, for instance in the health care domain or in field engineering [1,2,3]. The integration of PDA in networked applications, though, remains difficult and expensive for three reasons:

- *Resource Limitations.* PDAs impose limitations on client functionality because of comparatively limited user interface, memory and computing resources. These limitations imply a high adaptation cost for adapting a client to the available resources, for example for development of user interface components that require less screen real estate.
- *Network-level integration.* The facilities for connecting to networks vary with available PDAs, but in general are rather low-level, thus implying additional cost for realizing the connectivity required for a PDA multimedia client.

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- *Expensive PDA Software Development.* PDA software development is comparatively expensive for a number of reasons. PDAs in general come with their own development environments [e.g. 4,5,6]. These environments have not yet matured to the efficiency and reliability available on standard platforms. Further, there is a lack of experience in PDA software development in general, and PDA software developers are hard to find. Last not least, software components developed for standard platforms are difficult to reuse or even to port to PDA, and reusable PDA software components are not yet available to any noticeable degree.

In this paper, we present the tool PocketWeb as a generic solution for integration of PDAs as multimedia clients in mobile multimedia applications. Pocket Web facilitates integration of PDA in applications based on the World-Wide Web protocols. From an end user perspective, PocketWeb is a web browser on Apple Newton MessagePad. From an application developers perspective, though, PocketWeb enables PDA integration in networked applications without requiring software development on PDA, thus reducing the cost of PDA integration effectively. Regarding client adaptation to limited resources on PDA, PocketWeb embodies a number of built-in adaptation strategies based on a thorough analysis of the design space for a multimedia client on PDA.

In the following section we will discuss resource limitations on PDA, and the options for handling them. This discussion leads to consideration of pre-processing of multimedia information for a PDA client. The discussion of the design space for a PDA multimedia client extends to consideration of network-level integration in section 3. In section 4, we will describe the PocketWeb tool and briefly compare it to related work. Finally, in section 5 we will describe the application of PocketWeb to integration of PDA in MILLION, a large distributed multimedia system for the tourism sector currently being developed in an ESPRIT co-funded project [7]. The paper concludes with a brief summary and outlook on further development.

2 Resource Limitations and Multimedia Preprocessing

Today's information system clients such as WWW browsers have lots of built-in modules to display the different types of multimedia information. Apart from the weak computing power, discussed later in this document, PDAs have several other restrictions that makes it difficult to present multimedia information.

These are:

- small display
- limited colour depth
- small memory
- weak computing power
- poor digital audio interface

2.1 Restrictions concerning the display of PDAs

The usual size of displays known from Desktop computers is between 14" to 21" and the size of the display from Laptop computers is about 12". Compared to these values the size of PDA displays, from about 3" to 6", is very small.

Most of the information available on information systems are thought to be displayed on a display with at most 80 columns. It is no problem to reformat plain text to a smaller display, for example to 50 columns but this is not as easy for tables or multimedia information as pictures or video.

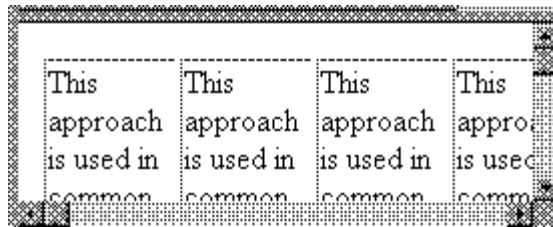
2.1.1 Tables:

Tables need a lot of space because they use additional characters to separate the single columns. This leads in almost every case to a larger width than the available 50 columns on a PDA.

There are several strategies to display a table on the small display:

1. two scrollbars

Usually the user has the possibility to navigate up and down through the document. In addition to this vertical scrolling a horizontal scrolling is used to view the table.



This approach is very inconvenient for the user because it is necessary to scroll for every row from the left to the right margin to view the table. Also it is difficult to overlook the whole table and to remember the position within the table. If the first column can be locked, that means the first column is not scrolled and always shown, it is easier to remember the position within the document. The disadvantage is that the space is always used for the first column.

2. reformat the single columns

This approach is used in common HTML viewers. The available space is divided into the number of used columns and the text is reformatted to fit into the column.

This approach is used in common HTML viewers	This approach is used in common HTML viewers	This approach is used in common HTML viewers	This approach is used in common HTML viewers	This approach is used in common HTML viewers
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This above table is divided in 5 columns of almost the same width. The single columns are separated with one character as delimiter. So the average size of a single

column is about 9 characters. This means that usually only a maximum of two words fit on a single line within the column. A lot of space is lost if only one word fits on the line because the second word is too long. In this case we can force a word break to use the remaining characters. This is shown in the fifth column. Without a forced word break, that makes the document harder to read, the length of the document growth very fast.

3. *Don't use a table. Reformat the table to multiple sections.*

The idea that leads to this approach is, that a table contains in every row the information that belongs under a given topic to a given point. This is not always applicable but will do for the most cases.

The following example shows the original table

Company	Modell	Price	Size
Apple	MessagePad 130	800 USD	90mm x 140mm x 25mm
Psion	Serie 3c	750 USD	110mm x 70mm x 20mm
US Robotics	Pilot	300 USD	60mm x 80mm x 15mm

and the decomposition to multiple sections

Company: Apple
Modell: MessagePad
Price: 800 USD
Size: 90mm x 140mm x 25mm
Company: Psion
Modell: Serie 3c
Price: 750 USD
Size: 110mm x 70mm x 20mm
Company: US Robotics
Modell: Pilot
Price: 300 USD
Size: 60mm x 80mm x 15mm

This approach is useful for tables where it is not necessary to compare the different rows.

4. Use floating columns

This approach uses the basic characteristics of a table. A table is a formation with a separation into columns and rows. It is not essential that the columns always start at the same horizontal position. It only must be recognisable for the user to which column the current text belongs.

If the display supports colours a better separation of the columns can be reached by the use of different background colours.

This approach results in a very uncommon structure and is therefore only acceptable on very small displays.

5. Ignore the table

At first sight this approach may look mad or trivial but on a closer look it is at least reasonable to ignore the table construct in some cases. This approach can only be used in addition to another approach to display tables where it is not possible to ignore the table construct.

As We May Think	This article was originally published in the July 1945 issue of "The Atlantic Monthly". As Director of the Office of Scientific Research and Development, Dr. Vannevar Bush has coordinated the activities of some six thousand leading American scientists ...
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This leads to the question which table constructs can be ignored? In many cases tables are used to have a nicer presentation of the information. But on a small display this brings the contrary result. Deciding where it is possible to ignore the table or not can only be done by an heuristic algorithm.

As We May Think
This article was originally published in the July 1945 issue of "The Atlantic Monthly". As Director of the Office of Scientific Research and Development, Dr. Vannevar Bush has coordinated the activities of some six thousand leading American scientists ...

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