

A Concept Mapping Tool for Pocket PC Computers

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Abstract

We describe the implementation and evaluation of a concept mapping tool for Pocket PC computers. The paper addresses challenges associated with developing a learning tool for handheld computers, including reduced screen size, availability, connectivity and usability.

Keywords: handheld computers, mobile learning, usability, user interface, user interactions.

1. Background

According to an estimate from Microsoft (Microsoft, 2001) by the end of the year 2002 there will be nearly 100 million personal digital assistants (PDAs) in use worldwide. One important emerging application of these handheld devices is mobile learning (Sharples, 2000). A Handheld Learning Resource (HandLeR) is a personal handheld computer designed to support personal learning projects (Sharples, Corlett, & Westmancott, Forthcoming). The proposed device will be in constant network communication. It will enable learners to capture, organise and share context-specific multimedia objects such as notes, sounds and images. It will support fieldwork and provide a range of learning resources including virtual laboratories, collaboration and messaging services, and teaching material.

A demonstrator HandLeR system was developed in 1999 as an undergraduate project at the University of Birmingham. Its hardware was based on a Fujitsu Tablet Computer running at 233MHz with additional attachments that included a Nokia Card Phone and a digital web camera. The operating system was Windows 98 and the software integrated applications for note taking, drawing and image capture.

Its custom-designed interface was based on a personal avatar (depicted as a cartoon figure) whose body parts can be tapped with the stylus interaction device to access tools such as the camera and integral mobile phone. Tapping its "brain" launches a concept mapping tool with visual display of nodes and links, plus a history list of recently-created notes, visited websites and other items, which can be linked into the map (Figure 1). The concept map

provides the primary way of organising information on the HandLeR. A concept map (or mindmap) (Buzan, 1989) is a tool for recording and organising information through visual semantic association. The HandLeR system provides an interface to a concept map designed for pen-based interaction on a small screen. The user can navigate through the map by clicking on one of the outer nodes which brings it to the centre and displays the topics related to it. Clicking on the centre node brings up the item (such as a note or web page) associated with it. To add a new item, the user drags an item from the history list to the centre node, to which it is then attached.

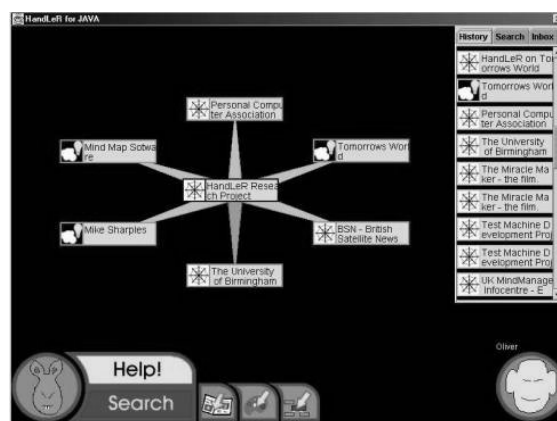


Figure 1. Concept Map of the first HandLeR.

2. HandLeR for the Pocket PC

The first HandLeR prototype demonstrated the concept and feasibility of a mobile device for experiential learning. In this paper we describe a redesign of its concept map software for the Pocket PC.

2.1. Hardware Platform

The new system, called "HandLeR Map-It!", was developed for Pocket PC devices running on Microsoft Windows CE 3.0 (WinCE) Operating Systems. The reason for choosing WinCE over Palm was the better processing power, memory expandability and multimedia

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capabilities on most Pocket PC devices. The hardware specification for the testbed system is:

- Compaq iPAQ H3760 / H3870 computer
- Intel / ARM StrongArm SA1110 206 MHz processor
- 64MB RAM
- PCMCIA Expansion Jacket
- Orinoco WaveLan Wireless LAN card

2.2. Concept Map Software for Pocket PC

Due to the smaller screen size (240 X 320 pixels on the iPAQ compared with 800 x 600 on the Fujitsu Stylistic) a direct port of the original software to the Pocket PC is unrealistic. Thus, the concept map was redesigned for the smaller screen.

Navigation on the concept map remains largely the same as it was in the first prototype. Tapping on an outer node brings it to the centre, and tapping on the central node opens the item associated with it. The file list shows the contents of the My Documents folder and is organised as a 'history' list with the most recently created items at the top. Several features were added. First, the text label for each node will change to italic if the node does not contain any content material. This allows the creation of "dummy" nodes that could help users to organise their concept ideas. Second, the last node to be viewed with is highlighted in blue, with the aim of assisting the user to navigate the concept map more easily (Figure 2a).

The *alter ego* that was used for interaction in original prototype was removed, as the smaller screen size would not accommodate it. The features it provided, primarily for launching applications, was replaced by a simpler application launcher with a list of the available software applications (Figure 2b).

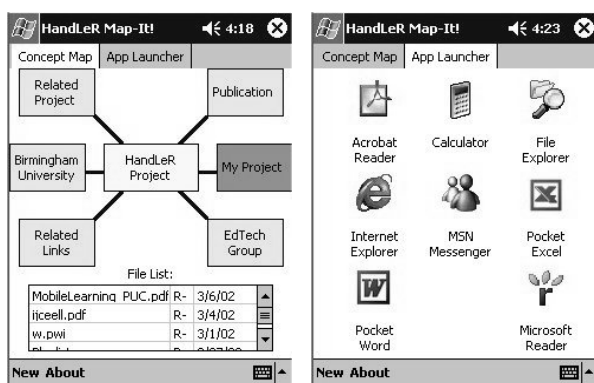


Figure 2. Main screen of HandLeR Map-It! showing a) the Concept Map and b) the Application Launcher.

The design took account of the pen-like stylus as the primary method of interaction on a PDA. Unlike interaction by a mouse on a desktop machine, there are no

ways to bring up a contextual menu through right click on PDAs. This is replaced by 'tap and hold' for a contextual menu within Map-It! (Figure 3).

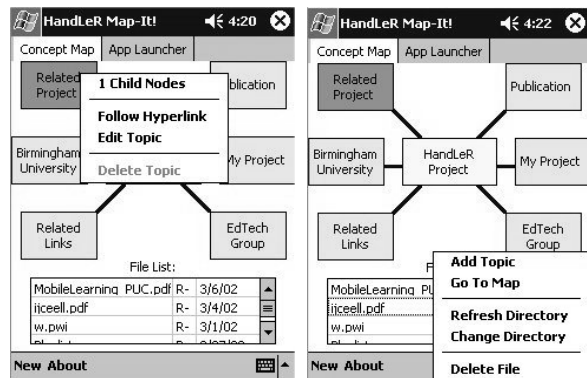


Figure 3. "Tap and Hold" popup menus depending on context; a) popup menu on concept map and b) popup menu on File List.

The system uses tap and hold menus extensively to perform tasks such as Add Topic, Delete Topic, Edit Topic and to display the number of links from each outer node. It was hoped that this arrangement would reduce the need to access the menubar and so provide a better way to interact with the various system components.

In order to accommodate both novice and expert users, Map-It! provides multiple ways to conduct a single task. For example, to add a new topic to a concept map, a novice user may choose to use the wizard-like interface (Figure 4) by clicking on "New" on the menubar. The users will then be asked a series of questions in order to guide them through the process. Conversely, an expert user may wish to add the topic to the concept map as quickly as possible. Providing that the content is stored locally, this can be done by holding the stylus on an item in the file list to invoke the popup menu and then selecting "Add Topic".



Figure 4. Wizard-like dialogs guiding users to add a new topic.

3. Implementation and Design Issues

The Compaq iPAQ devices used in the development are slim and light. Although the use of the PCMCIA expansion jacket and wireless LAN card increased the weight and the size of the device (weight: 300g; dimensions: 16cm x 9cm x 3.5 cm), it is still significantly more portable than the original HandLeR system implemented on a Fujitsu Stylistic tablet computer. Performance was impressive during a video streaming test. Pre-prepared video specifically designed for the Pocket PC using Windows Media Encoder (Windows Media Version 8 format, bitrate at 384kbps) was streamed into the device in real time using wireless LAN from a web server with no performance drop. Application loading time reduced dramatically as a consequence of applications being loaded from memory instead of from hard disk (4-6 seconds on iPAQ compare with 30-60 seconds on Fujitsu Stylistic). Battery life has increased from 1-2 hours of the original HandLeR on the tablet computer to more than 6 – 9 hours (with and without wireless LAN respectively) on the Pocket PC. The Pocket PC currently lacks some of the applications and accessories of the tablet computer such as a digital camera, but these are becoming available.

4. Heuristic Evaluation

Heuristic evaluation is an informal usability evaluation technique developed by Jakob Nielsen (Nielsen, 1994). Three people with expertise in interface design within the Educational Technology Research Group were selected to assess the interface and interaction of the Map-It! prototype, against a set of usability heuristics adapted from Nielsen (Nielsen, 1994). These covered Visibility of System Status, User control and freedom, Consistency, Flexibility and shortcuts, Ease of Use, Error Prevention, and Help and Documentation.

It was observed at the beginning of the evaluation session that the evaluators were tending to use the wizard-like dialog boxes to create or add topics to the concept map. Towards the end of the session evaluators began to use a combination of methods (file list, application launcher and wizard) to create or add topics.

Evaluators' overall responses to the system were favourable, particularly in the area of ease of learning and operating the system. Responses in the area of consistency were also positive. The help system and supplemental reference materials were rated as acceptable.

The evaluators did discover several usability problems. The most severe problem was that they had some difficulty when navigating the concept map, because the previously visited node did not appear in the expected position. This can be solved by altering the way that HandLeR Map-It! retrieves information from the Windows CE property database (CEDB) which hosts the

details of the concept map. Other minor issues found during the evaluation include the fact that users were able to delete a content from the file list while the content was still connected to the concept map (safeguards should be implemented to prevent this), the use of technical language and shorthand when interacting with contents using the file list (such as D to indicate a directory and R for a Read Only file), inputting text using the on-screen keyboard and difficulty when viewing websites that are not designed for Personal Digital Assistant.

Most of these issues can be overcome by redesigning the current implementation or by providing users with better training for using a PDA (such as using various inputting methods). Some issues however were caused by the limitations of the device itself (particularly screen size) and further work therefore is necessary to discover whether these limitations discourage useful learning on these devices.

5. Conclusion

The development of the HandLeR system for the Pocket PC allows users to have more freedom in using the device than the original HandLeR. The initial heuristic evaluation indicated a few minor usability issues that still need to be resolved. The findings of the evaluation also suggested that users using these handheld computers need to be retrained with new interaction skills such as writing on screen using the Block Recogniser in-order to take full advantage when using the system. It is still unclear how these mobile devices might affect learning, and while the reduced size, weight and extended battery life of the hardware allow greater freedom of usage, the impact of the reduced screen on usability is still unclear. The plan at this stage is to review the current interface and interaction design and the system architecture for exchanging learning materials and thus to improve the user experience while using such devices in learning.

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