A Systems Architecture for Handheld Learning Resources

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We are about to witness a convergence of handheld computers, digital cameras and broadband mobile communications into an integrated handheld or wearable device. It will enable people to browse the web and run multimedia software while on the move, to capture and store images and sounds, to annotate these with notes and sketches, to include this information as part of phone conversations, and organise and share it with people around the world.

The hardware already exists (for example, the Qbe pen-tablet computer/camera) and it can communicate via a Wireless LAN link at speeds up to 11Mb per second, but it is expensive (at around $3,000) and the high speed communication is only possible within a confined area such as a university campus. Once the cost falls to less than £1,000 and the next generation of mobile telephony provides wide area connection at speeds above that of a current fixed line telephone modem, then they will be sold as consumer devices. Children will buy them to play global multi-player video games, adults for use as mobile offices. The reaction of schools and universities to these powerful communications and computing devices is likely to be the same as for previous mobile technologies such as the pocket calculator and the mobile phone: they will initially exclude them and belatedly attempt to incorporate them into classroom education.

The aim of the HandLeR (Handheld Learning Resource) project is to investigate the design of such technologies as personal aids to lifelong learning, to produce demonstrator systems whose designs are based on sound theories of experiential, collaborative and lifelong learning, to explore their use in future learning contexts that bridge formal and informal learning, and to provide advice on how to incorporate them into institutional education. We have chosen four scenarios as being representative of the range of uses for such mobile learning technologies: children aged 9-11 on a field trip; students moving around a University campus; young adults carrying out professional development at home and in the workplace; and elderly people capturing, organising and reflecting on a lifetime of experience.

A previous paper (Sharples, 2000) proposed requirements for the design of HandLeRs based on a theory of technology-mediated lifelong learning. In this paper we outline a generic systems architecture for HandLeRs and describe the implementation of a prototype system. One key requirement is that the core learning environment should remain stable over a long period of time, as the learner matures from child to adult, even though the delivery devices and interface may change. The learner must be able to recall material and ideas acquired months or years before, revise it and adapt it to new knowledge and contexts. We have therefore based the systems architecture on two general theories of learning — Kolb's experiential learning cycle and Pask's conversation theory — that apply equally to child and adult learning. They offer implementable mechanisms to support everyday capture, organisation and communication of knowledge, to combine experiential and reflective learning, and to bridge formal and informal learning contexts.

There are four main components to the generic HandLeR system: a set of tools to capture and annotate events, a web browser, a database manager to organise and relate the events as a knowledge structure, and a communications manager to support synchronous voice and data communication and asynchronous sharing of knowledge. The capture tools include a notepad with handwriting or voice recognition, an integral still and video camera, and a drawing package.

A learner might point the camera and take a picture which is immediately displayed on the screen. The learner could then annotate it using the drawing package and drop the picture into a page of notes. A graphical time-line holds all the learning items, including note pages, web pages, individual images, sounds and video. At any point the learner can move from capturing events to viewing and organising them into a continually growing visual map. At any time there is a node at the centre of the view, and associated nodes are shown around it. An item can be dragged from the time-line onto the central node, and this creates a new association. By selecting an outside node, it moves to the centre of the view, and clicking on the one in the centre opens the event it holds. By clicking on related items the learner can explore an idea or follow trails of association.

Each event in the time-line is stored as HTML, so linking these events together in a visual map creates an instant website. The items and their links are stored in SQL databases on the handheld computers. This information can be sent to other learners across networks or the Internet, to a remote information server, or straight to the worldwide web.

For example, a learner on a field trip might start with an introductory idea map of briefing notes and web resources and then capture more field notes and camera images, adding them to the map to form a small website that can be viewed and shared over the internet. Two or more people might work together on a project, sharing their notes and creating a combined map by merging the data via a mobile phone or wireless LAN. The HandLeR also functions as a mobile phone, allowing learners in different locations to talk about their shared notes and ideas.

The systems architecture is designed for personal learning at any age or in any context, but the interface and interaction needs to be adapted to different types of learner. For children we have produced an interaction design based on a personal “mentor”, which appears on the screen as a favourite character or animal. It provides the means of interacting with the tools and resources. Clicking on its eyes, for example, shows the camera viewfinder, and clicking on its head moves to the idea map. For adults, the interface may require a more Windows-like set of icons.

We have implemented a prototype generic HandLeR and have carried out formative studies of ease of use and effectiveness.

Sharples, M. (2000). The Design of Personal Mobile Technologies for Lifelong Learning. *Computers and Education, 34*(177-193).