A Study of Input Devices used on Personal Digital Assistants (PDAs)

Introduction
This paper describes the results of an independent study into the effectiveness of Personal Digital Assistants (PDAs). Personal Digital Assistants are compact computing devices that serve to replace the traditional, paper-based personal organiser. They enable the user to conveniently carry out a number of tasks such as taking notes/memos, storing and retrieving names and addresses, and managing appointments/schedules. Models currently available include the 3Com Palm Pilot, Hewlett Packard Jornada, and Philips Velo. These also offer a range of sophisticated facilities such as e-mail and word-processing applications that are normally only found on desktop computers. The primary appeal of PDAs lies in their compactness and independent power source and the mobility that this implies. The physical interface of the desktop computer usually consists of input and output devices e.g. a keyboard, mouse and monitor. However, the compact nature of the PDA has meant that the input devices are much smaller than their desktop counterparts. As a result, they can be more difficult to use, especially in unstable environments e.g. on moving trains, cars etc.

This paper reports on a study to evaluate the effectiveness of input devices used on three PDAs. The aims of the study were:

- To determine the most effective input device used on three currently available PDAs in terms of speed and accuracy;
- To determine which input device or combination of input devices was preferred the most by users;
- To generate a number of design guidelines to inform the design of future PDAs and input devices.

Design & Methodology of Study

The PDAs:
- Amstrad PenPad: Input device was stylus only (pen-like instrument).
- Philips Velo (Windows CE): Input device combination was a stylus and keyboard.
- Casio Cassiopeia (Windows CE): Input device combination was a stylus, keyboard & voice-activation (voice-activation software enables opening of different software applications).
The Users
13 paid subjects (7 males and 6 females, ranging from 22-33 years of age) from the Ergonomics and Psychology departments at University College London were recruited for the purposes of the study.

Methodology
In the study, each user was required to perform a number of typical, “everyday” tasks (saving and editing an address; entering, saving and editing a simple appointments schedule; and entering, saving and editing a short memo) using the different types and combinations of input devices found on the PDAs. Each user was video recorded whilst they performed the tasks to extract further information such as how long they took to complete each task and how accurately they completed it. Each user was then interviewed in order to ascertain their attitudes/feelings towards the different types of input devices.

The interview covered issues related to the input devices such as their perceptions about the time it took to carry out the tasks; their feelings towards the accuracy of the input devices when carrying out the tasks; the amount of effort that was needed whilst using each input device; how well suited they thought the input devices were for the tasks; how appropriate the input devices were for use in mobile and unstable situations; and the users’ overall preferences for input devices.

Results & Conclusions
Users were able to enter and edit addresses and appointments significantly more quickly and accurately when using the Philips and Casio PDAs than when using the Amstrad. This was because the presence of a keyboard allowed the quick and accurate entry of text.

The Philips and Casio offered very similar performance in terms of speed and accuracy in all tasks. Users preferred the keyboard and stylus combination found on the Philips not only for speed and accuracy reasons, but also because it the input devices were similar in functionality to a windows-style desktop computer. The slowness of task completion times and accuracy levels achieved on the Amstrad was mainly attributed to the inaccuracy of its handwriting recognition software. However, the memo task was performed more quickly using the stylus-only based Amstrad than on the other two machines.

This was because the Amstrad’s memo facility was essentially an electronic sketchpad and did not involve handwriting recognition. The voice-activation facility (used by the Casio) was not popular, mainly because it did not reduce the time taken to carry out typical tasks. As it still required the use of a stylus to operate it, users felt that it did not make the tasks easier. The stylus-only input of the Amstrad was extremely unpopular for performing typical tasks, mainly because the Amstrad’s handwriting recognition software meant that tasks were performed in a very slow and inaccurate fashion.

In conclusion, a keyboard and stylus combination should be used for future PDA designs because it allows tasks to be carried out quickly and accurately. Although the voice activation facility (found on the Casio) did not provide obvious benefits in terms of speed and effort, users still expressed a desire to see the technology used more extensively and effectively in future PDAs. A stylus-only input style is not desirable, as performance is unlikely to match that achieved by a keyboard and stylus combination.
Design Guidelines

Use of keyboards for text entry
- Provide a keyboard for tasks involving text entry, e.g. entering addresses, producing letters, creating appointments lists etc. in PDAs. Keyboards allow accurate and quick entry of text and are also suitable for use in unstable environmental conditions e.g. on moving trains etc. Keyboards should be of an acceptable size to allow the accurate entry of text in both stable and unstable environmental conditions.

Include a stylus as a pointing & selecting tool
- Provide a stylus for use as a pointing and selection device. This should be functionally similar to a mouse. Styluses are also useful as a freehand scribbling and drawing tool for memo/note taking where no handwriting recognition is required.

Ensure that handwriting technology is both accurate and provides fast feedback
- If a PDA is to be stylus-based (e.g. if severe space constraints exist), it is important to make use of the most reliable handwriting recognition software available (i.e. software with a very high accuracy rate) as users become very frustrated with even minor failings in accuracy. Handwriting recognition software should provide the user with acceptably fast feedback of their actions, as slow character conversion time increases the time it takes to carry out even the simplest of tasks. An on-screen keyboard (“soft keyboard”) should be provided as an alternative means of entering textual information – especially important as a back-up method of input in unstable conditions.

Make use of a recognisable and familiar interface metaphor
- Use a software environment that utilises a desktop metaphor/paradigm i.e. a windows-style environment (e.g. Windows CE), because users like to use software that is recognisably similar to the one they use at the office or at home. This allows users to make use of their existing knowledge of windows-style software when using PDAs.

Ensure that speech technology is truly “hands free”
- Speech-activation technology should enable the user to carry out tasks or activities without the use of a keyboard or stylus i.e. it should truly be “hands free”. The inclusion of speech-activated facilities should provide the user with an alternative way of performing tasks or activities.

Attempt to maximise the potential of speech activation technology
- Speech technology should be used to enhance command activation for facilities within software applications to reduce the need for the user to remove their hands from the keyboard. Users want to be able to carry out tasks using their voice whilst they work on other tasks e.g. voice-activate the “save” or “bold text” function whilst they type a letter. Users also want to be able to dictate textual information into applications such as word processors or notepad/text editors. Therefore, voice-activation technology should be used in a sensible way rather than as a novelty attraction.

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