Two Years and Six Hand-held Devices Later: What I Have Learned

By [Michael Bohan](#)

Lets face it, mobile computing is hot. Nowhere was this more evident than during this years PC Expo, where for the first time it looks as if desktop PC's took a back seat to the latest mobile computing device technologies. These technologies range from "stick-of-gum" sized memory modules for use in portable devices to digital cameras, MP3 players, and of course, handheld computers. The latter, also referred to as personal digital assistants (PDAs), personal information managers (PIMs), or palm-sized PC's, have enjoyed a particularly large part of the computing spotlight this year. With recent announcements from big names such as Sony, Samsung, and AOL, it seems as though everyone is trying to grab a slice of the handheld pie.

Because of this growing interest, it is more important than ever to address the major usability issues that stem from using these type of devices. This article is intended to discuss some of the more obvious usability issues for handheld computers and describe how the two biggest names in the consumer handheld computing industry today - Palm and Microsoft - have, so far, dealt with these issues.

Storage and retrieval

The first issue has to do with information storage and retrieval. How do we organize, store, and present data on a handheld computer so that it can be readily accessed and efficiently interact with other devices? Microsoft's Pocket PC^{TM} organizes information by having an operating system which is based on the desktop metaphor and as such, employs a hierarchical filing and navigation structure. The Palm OS^{TM}, on the other hand, borrows some of its organization from desktop computing, but it's core relies on a single level filing and navigation structure.

As human factors specialists, we might be quick to say that the latter Microsoft approach is more appropriate; after all, deeper structures take longer to navigate and demand more working memory resources and the like. However, the answer to this question may have as much to do with philosophy as with usability. For instance, Microsoft's concept of a handheld computer is just that - a personal computer that can be placed in your pocket. This could be thought of as a laptop computer that has been shrunken down to fit into one's palm. One result of this design philosophy is a more powerful operating system that is capable of doing most of the things that the typical desktop computer can do (e.g. spreadsheets, word processing, and multimedia). A questions arises here is whether all of these functions are really necessary (or even appropriate) for hand-help computers? Not according to Palm.

The design philosophy driving the Palm OS^{TM} is the K.I.S.S. (keep it simple, stupid) principle; do fewer things, but do them well, which will maintain a good user experience. Thus, they view the hand-held computer as an extension to the desktop computer, enabling the user to carry only the essential data

with them, but being able to access this data quickly.

Display information

The second issue is how to display the information on the screen itself. Palm recently introduced a color hand-held device, but it uses monochrome displays for all of its other devices. The same is true for other device manufactures that use the Palm OS^{TM} (e.g. Handspring and Symbol). Pocket PC^{TM} other the other hand, is used primarily in conjunction with color displays. Again, our first reaction might be that color is better. True, color is an important cue for processing our environment, but in the hand-held computing environment the use of color comes down to two things, current technology and functionality. While color will eventually become standard on all hand-held computers and cellular phones, limitations in existing technology preclude this from being the case today. Color displays demand a great deal of power and processing resources and as such, currently make them costly and of limited use.

Moreover, others have argued that color is not really important for hand-held devices because it adds little to the user experience. For example, much of the benefits of color are only to be had by a few applications, such as web browsing, picture viewing, etc. In addition, the primary function of these devices today is personal information management, which really does not gain much from the addition of color. Undoubtedly, more important issues for today's hand-held computing devices are display contrast and resolution (current resolution used on Palm displays is 160 x 160 dpi) - although the same argument for the limited use of color could also be applied to the issue of resolution. For instance, to what level does readability increase on these devices with a given increase in resolution?

Data entry

Finally, there is the issue of input. Data entry on hand-held devices has been, and continues to be, a major bottleneck in the advancement of this technology. While handwriting is arguably the most intuitive interaction method for handheld computers, current handwriting recognition technology is still hovering around 85%-93% accuracy (Gibbs, 1993; MacKenzie & Chang, in press; McQueen, MacKenzie, Nonnecke, Riddersma, & Meltz, 1994), with text entry speeds of around 16 -18 wpm (MacKenzie & Chang, in press; MacKenzie, Nonnecke, Riddersma, McQueen, & Meltz, 1994). It is interesting to note that users are only willing to accept error rates of approximately 3% (LaLomia, 1994). One of the challenges for human factors researchers has been to develop alternative text entry methods by using on-screen keyboards, etc. The problem is that these devices are aimed at the "walk-up" market consumers who want to be able to use it immediately with little or no training.

As far as walk-up text entry methods, we found (e.g. Bohan, Phipps, Chaparro, & Halcomb, 1999) that for immediate use, the standard QWERTY keyboard layout works best. This is possibly due to keyboard familiarity issues. However, the QWERTY layout itself is not very efficient, with text entry rates somewhere around 20-25 wpm. Other layouts have achieved text entry speeds upwards of 40 or 50 wpm, but only after extensive training. At present, both the Palm and Pocket PC environments are driven primarily by character recognition systems, rather than handwriting recognition proper. That is, instead of the computer learning the idiosyncrasies of each individual's handwriting, the user learns a standard set of pen strokes or gestures that represent letters, symbols, etc. The Graffiti system^{TM} used by Palm requires fewer strokes per letter, but the strokes are more archaic. The Jot system^{TM} used by Microsoft relies on pen strokes that are more similar to those used in real handwriting, but require more strokes per character. At present, these two systems, to my knowledge, have not been compared empirically for text entry performance.

Where Do We Go From Here?

As wireless data access becomes cheaper and faster over the course of the next 3-5 years, there is no doubt we will see an explosion in hand-held computing. Indeed, Forrester Research (2000) estimates that 36% of all U.S. households will use hand-held computing devices by the year 2003. Given this rapid growth, it will become increasingly important to empirically investigate the usability issues involved in using these devices. We, in the human factors and usability communities, are in a terrific position to make a significant impact on the devices of the future.

REFERENCES

Bohan, M., Phipps, C.A., Chaparro, A., & Halcomb, C. (1999). A psychophysical comparison of two stylus-driven soft keyboards. Proceedings of Graphics Interface '99, 92-97.

Forrester Research (2000). (as cited by Rosen, L. (2000). Newsprint without the print. UpsideToday) [Online] http://www.upside.com/texis/mvm/story?id=396f87e60

Gibbs, M. (1993, March/April). Handwriting recognition: a comprehensive comparison. Pen, 31-35.

LaLomia (1994). User acceptance of handwritten recognition accuracy. CHI '94, 107.

MacKenzie I.S., & Chang, L. (in press). A performance comparison of two handwriting recognizers. Interacting with Computers.

MacKenzie, I.S., Nonnecke, B., Riddersma, S., McQueen, C., & Meltz, M. (1994). Alphanumeric entry on pen-based computers. International Journal of Human-Computer Studies, 41, 775-792.

SUBSCRIBE to *Usability News*!