

The Development of the Personal Digital Assistant (PDA) Interface

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INTRODUCTION

The original idea of a portable computer has been credited to Alan Kay of the Xerox Palo Alto Research Center, who suggested this idea in the 1970s (Kay, 1972a, 1972b; Kay & Goldberg, 1977). He envisioned a notebook-sized, portable computer named the Dynabook that could be used for all of the user's information needs and used wireless network capabilities for connectivity.

BACKGROUND

The first actual portable laptop computers appeared in 1979 (e.g., the Grid Compass Computer designed in 1979 by William Moggridge for Grid Systems Corporation [Stanford University, 2003]). The Grid Compass was one-fifth the weight of any model equivalent in performance and was used by NASA on the space shuttle program in the early 1980s. Portable computers continued to develop in the 1980s onwards, and most weighed about 5kg without any peripherals.

In 1984, Apple Computer introduced its Apple IIc model, a true notebook-sized computer weighing about 5kg without a monitor (Snell, 2004). The Apple IIc had an optional LCD panel monitor that made it genuinely portable and was, therefore, highly successful.

In 1986, IBM introduced its IBM Convertible PC with 256KB of memory, which was also a commercial success (Cringely, 1998). For many, this is considered the first true laptop (mainly due to its clamshell design) that soon was copied by other manufacturers such as Toshiba, who also was successful with IBM laptop clones (Abetti, 1997). These devices retained the A4 size footprint and full QWERTY keyboards and weighed between 3 and 4 kg. Following these innovations, Tablet PCs with a

flat A4 footprint and a pen-based interface began to emerge in the 1990s.

There were several devices in the 1970s that explored the Tablet, but in 1989, the Grid Systems GRiDPad was released, which was the world's first IBM PC Compatible Tablet PC that featured handwriting recognition as well as a pen-based point-and-select system. In 1992, Microsoft released Microsoft Windows for Pen Computing, which had an Application Programming Interface (API) that developers could use to create pen-enabled applications. Focusing specifically on devices that use the pen as the primary input device, this interface has been most successfully adopted in the new breed of small highly portable personal digital assistants.

In 1984 David Potter and his partners at PSION launched the PSION Organiser that retailed for just under £100 (Troni & Lowber, 2001). It was a battery-powered, 14cm × 9cm block-shaped unit with an alphabetic keyboard and small LCD screen, with 2K of RAM, 4KB of applications in ROM, and a free 8KB data card (which had to be reformatted using ultraviolet light for reuse). Compared to the much larger notebook computers of the time, it was a revolutionary device, but because of its more limited screen size and memory, it fulfilled a different niche in the market and began to be used for personal information management and stock inventory purposes (with a plug-in barcode reader).

In the late 1980s and 1990s, PSION continued to develop commercially successful small computing devices incorporating a larger LCD screen and a new fully multi-tasking graphical user interface (even before Microsoft had Windows up and running). These small devices were truly handheld. The dimensions of the PSION 3c (launched in 1991) were 165mm×85mm×22 mm, with a 480×160-pixel LCD screen; the device weighed less than 400g. A small keyboard and innovative touch pad provided control of the cursor, and graphical icons could be selected

to start applications/functions and select items from menus. The small keyboard proved difficult to use, however, and the following 5c model in 1997 used an innovative foldout miniature QWERTY keyboard. These genuinely handheld devices with their interface innovations and ability to synchronize data with a host personal computer made the PSION models particularly successful and firmly established the personal digital assistant (PDA) as a portable computing tool for professionals.

ALTERNATIVE INTERFACES AND THE INTEGRATION OF MULTIMEDIA

The limitations of keyboard-based data entry for handheld devices had been recognized, and following PSION's lead, Apple Computers introduced the Newton Message Pad in 1993. This device was the first to incorporate a touch-sensitive screen with a pen-based graphical interface and handwriting-recognition software. Although moderately successful, the device's handwriting recognition proved slow and unreliable, and in 1998, Apple discontinued its PDA development (Linzmayr, 1999). However, the PDA market now was becoming based firmly upon devices using pen-based handwriting recognition for text entry, and in mid-2001, PSION, with dwindling sales and difficulties with business partnerships, ceased trading. US Robotics launched the Palm Pilot in 1996, using its simple Graffiti handwriting recognition system, and Compaq released the iPAQ in 1997, incorporating the new Microsoft Windows CE/Pocket PC operating system with the first PDA color screen (Wallich, 2002).

Microsoft's relatively late entry into this market reflected the considerable research and development it undertook in developing a user-friendly pocket PC handwriting recognition interface. This remains a highly competitive field, and in November 2002, PalmSource (the new company owning the Palm Operating System) replaced the Graffiti system with Computer Intelligence Corporation's JOT as the standard and only handwriting software on all new Palm Powered devices. Computer Intelligence Corporation (CIC) was founded in conjunction with Stanford Research Institute, based on research conducted by SRI on proprietary pattern recognition technologies (CIC, 1999). The original Graffiti sys-

tem relied on the user learning a series of special characters, which, though simple, was irksome to many users. The CIC JOT and Microsoft Pocket PC systems have been developed to avoid the use of special symbols or characters and to allow the user to input more naturally by using standard upper and lower case printed letters. Both systems also recognize most of the original Palm Graffiti-based special characters.

The arrival of the Short Messaging Service (SMS), otherwise known as text messaging, for cellular phones in the late 1990s led several PDA manufacturers to adopt an alternative Thumb Board interface for their PDAs. SMS allows an individual to send short text and numeric messages (up to 160 characters) to and from digital cell phones and public SMS messaging gateways on the Internet. With the widespread adoption of SMS by the younger generation, thumb-based text entry (using only one thumb to input data on cell phone keypads) became popular (Karuturi, 2003). Abbreviations such as "C U L8er" for "see you later" and emoticons or smileys to reduce the terseness of the medium and give shorthand emotional indicators developed. The rapid commercial success of this input interface inspired the implementation of Thumb Board keyboards on some PDAs (i.e., the Palm Treo 600) for text interface. Clip-on Thumb Board input accessories also have been developed for a range of PDAs.

Current developments in PDA-based interfaces are exploring the use of multimedia, voice recognition, and wireless connectivity. The expansion of memory capabilities and processor speeds for PDAs has enabled audio recording, digital music storage/playback, and now digital image and video recording/playback to be integrated into these devices. This and the integration of wireless network and cellular phone technologies have expanded their utility considerably.

Audio input has become very attractive to the mobile computer user. Audio is attractive for mobile applications, because it can be used when the user's hands and eyes are occupied. Also, as speech does not require a display, it can be used in conditions of low screen visibility, and it may consume less power than text-based input in the PDA. The latest PDA interface innovations include voice command and dictation recognition (voice to text), voice dialing, image-based dialing (for cell phone use, where the

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