The Making of the Palm Pilot – Reflections on a Minimal Information Appliance

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ABSTRACT

There have been few commercially successful revolutions in the design of interactive systems since the Graphical User Interface "desktop" metaphor has been widely accepted. One notable exception is the introduction of the Palm Pilot in 1996, an extremely useful information appliance that had very limited functionality but happened to work in practical environments. In contrast to its more elegant and powerful but less useful predecessors, like the Apple New–ton, it won the market and created a new way of computing.

In this paper, we use the notion of minimalism drawing on literature from music, art and literature to examine why the Palm succeeded, why its innovative successor Handspring failed, and why the current palmtops partly dismiss the appliance role and favor consistency over co-operability. Thus, the palm case is generalized to discuss the chances and problems of minimal application design and subsequent application development.

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Experimentation, Human Factors

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H5.2 Information interfaces and presentation (e.g. HCI): User Interfaces - Theory and methods, User-centered design

THE PALM: AN UNFORSEEN SUCCESS

Palm Computing started off very quickly, selling almost half a million units in the first seven months and quickly gaining dominance in the hand-held computing market. Currently, for 2004, the market volume for handheld computers is estimated to be around 11.3 million units. This immense market did not exist prior to the introduction of the Palm Pilot, the first palm-sized organizer. But the market has diversified, today the Palm series has to compete against the Windows CE handhelds, generally equipped with better displays, faster processors, and better networking capabilities. Despite these unfavorable engineering figures, the Palm series sells very well. It still draws on the qualities that enabled its success and fights with difficulties because changes to the original concept always carry the danger of losing its outstanding position. But what exactly are the qualities of the Palm handheld? Although economic factors such as the acquisition of Palm Computing by US Robotics made the Pilot's success possible in the first place, the reason why exactly the Palm succeeded not only over his competitors but also in forming a new market segment is to be sought in his superior usability and practicality.

A Piece of Carved Wood or Less is More!?

A number of things Palm carry the notion that reduction was the key to success. In a very insightful interview, Rob Haitani, a former Sony employee in charge of the Palm UI development, claims "every pixel counted", that giving up three-dimensional button emulation and the reduction of font size were important to the success of the product. [6] Jeff Hawkins, the founder of Palm, was said to walk around with a block of wood in his pocket, a prototype smaller than the PDAs at that time, to demonstrate that size and features had to be reduced to achieve greater portability.

However, as we can see now with the luxury of time, these were solutions to immediate limitations that the Palm faced during its conception phase: They made it possible to construct the device in its time, allowed useful information content to be displayed and processed – an example of brilliant engineering – but today they don't give the Palm series a principle advantage anymore as processor speeds, screen resolution and color depth keep increasing. Instead, the advantage turned into a disadvantage when, during the introduction of high-res Sony handhelds, no accepted standard was available; even the newest Palm OS draws little benefit from the increased pixel count for the sake of compatibility.

MINIMALISTIC ADVANTAGES

Previous attempts to create a handheld computer were commercially unsuccessful. Take the Apple Newton: it had a very sophisticated interface, but one of the primary functions, the handwriting recognition software, was severely lacking functionality when the Newton was first released. In contrast to other companies, Palm did not believe that 'the first-generation handhelds failed because they did not provide enough functionality' [3]. The Palm was less ambitioned, and tried to concentrate on the essential functionality that an ultra-portable computer needed. The design goal was to create a small, fast and inexpensive device.

Functional Minimalism? No 'Information Appliance'

As the traditional crafts differentiate between numerous types of tools for different tasks (e.g. hammers for hitting nails, paving stones or knees), and multi-function-tools are more often sold in do-it-yourself stores than successfully employed at work, it is attractive to transfer the concept of single-purpose tools to interactive systems. In [9], Norman expanded on the notion of 'Information Appliance', which is commonly applied to the Palm. While this seems fitting at first, Palm Pilots not being general purpose computers, it is misleading in the end: the Palm could always do more than one thing. It was designed to replace the business traveler's organizer, an analog physical tool with many functions. Precisely this combination of functions promises an added value of the electronic version, as cross-references need not be maintained by hand, and copies for backup or communication are faster and cheaper.

USING 'MINIMALISM' FOR ANALYSIS

Which qualities remain today from those that made the Palm successful? To examine this question, we let us be inspired by the phrase "less is more". Although these words often occur in HCI design literature [e.g. 7, 11], they are ill-defined at best. Often, it is expert knowledge in form of design experience that tells creating 'less interface' will result in a better product.

The motto of 'less is more' is not exclusive to design; it has been used in architecture, music and art before. A label that is often connected to this phrase is Minimalism, a term first coined in the sixties to describe the works of American artists such as Andre, Judd, Reinhardt or Serra that used extreme degrees of reduction in their works. Although many artists resented this term, it has since also been applied to musical works of Cage, Glass, Riley and others. In contrast to other terms that have been used by critics, this term stuck [4]. A number of different meanings exist that complement each other to form an interesting tool for analysis.

Structural Minimalism

From what is generally held to be the seminal exhibition on minimalism, the 'Primary Structures' show in New York in 1966 [10], one aspect of minimalist art has been structural transparence. By stressing simple geometries and making explicit the inner structure[1] of the exhibit, the viewer could understand how it 'worked'. We find the same ideal in Human-computer interaction, transparency being one of the primary demands towards interactive systems [6]. However, the minimalist perspective focuses not on mapping the artifact's structure to the structure of viewer's tasks but solely on the exposition of the internal structure of the work.

In the Palm Pilot, we find a high degree of structural minimalism, as a number of metaphors common to the desktop world have been replaced by a simpler internal structure that is transparently conveyed to the user. Design penetrates the system: Palm did not just design a user interface; the whole architecture is designed to fit the requirements. The initial versions of Palm OS allowed only one application to run at a time, introducing a simple mapping between what the device was doing and what it would display on the screen: what you see corresponds directly to the internal state. Likewise, the direct access to applications provided by four buttons on the lower front of the Palm case represents again a direct mapping, this time from input to state.

Because of this ease of switching between applications, the necessity of preserving changes arose. In contrast to almost all the known computing world, the Palm Pilot rejected the notion of files. There is no save; there is no file system (but for an invisible flat database store), so there is only the current state that will be automatically preserved. This simplified model of dealing with data has been present in Apple's Lisa, but since then operating systems forced users to differentiate between memory and disks, volatile and permanent information.

It is interesting to note that the design concepts for the Palm were not developed up-front, as Haitani says: 'It was more an end result of our pragmatic design approach, starting with the fact that we could only fit four buttons on the screen.' [3] By rigorous user testing, the most often used commands were optimized for performance. Haitani even developed something his fellow workers called religion: minimal click counting [5]: the ultimate goal for designing a given functionality was to reduce the number of stylus movements for the user. The result was an unconventional, yet rapidly usable interface.

Minimal Building Blocks

The minimalist paintings of Ad Reinhardt use only a single color (though in different shades), minimalist plastic art was constructed with the most simple shapes, cubes or cuboids; minimalist music could use only a single chord, or even a single tone. The complexity in these works is created through combination of these minimal building blocks.

Similarly, there are only few standard applications in the Palm OS: mainly a calendar, an address book, and a notepad. Each of these applications has only essential functionality as 'most people only use a small percentage of the features in an app' [3]. Still, combined use of these applications can create a powerful tool supporting complex tasks.

The absence of functions the user needs to choose from does not mean less work for the system developer. As an example, HotSync, the synchronization mechanism that allows the exchange of information with applications running on a PC, could not be simpler: it is just one button in the Palm's cradle that controls the two-way synchronization: when it is depressed, new information entered either

[1] Unfortunately, for interactive systems *the* inner structure is not defined; different levels of abstraction each create an inner structure, most of which are kept hidden (i.e. even programmers often don't consider hardware details).

into the Palm or the PC application[2] will be sent to the other device, so that both machines will have the same state afterwards. This outwardly simple operation is a more complex challenge to engineering than an interface with 'more features' that leaves more decisions to the user.

Minimal Patterns

The use of minimal patterns is closely connected to the use of minimal building blocks. However, while minimal building blocks focus on the structure of the artifact, the word pattern suggests the anticipation of change over time, or with subjective experience. In sculpture this can mean creating a room that needs to be explored and will change with the viewers change of point of view. In the case of minimal music, the combination and recombination of simple patterns create the composition as a complex interplay.

The Palm was developed through analysis of user needs at the sub-task level. There was no traditional hierarchical task analysis, and no pre-structured workflows were implemented. Examples can be found in Haitani's interview [3]: For the method of date entry for calendar items, continuous user testing yielded that some functionality the designers had integrated prominently into the interface, the administration of repeating dates, was not used very often. Thus, it was moved to a less accessible place, clearing up the more often accessed dialog. Also, categories for notes were decided to be exclusive, as this eased data input, and most users did not require multi-category membership.

Generally, the most often used functionality was optimized, harder to access, or would have to be removed completely. But this reduction yielded a system where the simple parts could be easily understood. It was therefore possible for the user to make the functions into operations he could combine to achieve his task at hand.

The concept of the Palm matched this attitude: instead of trying to reproduce PC functionality in a smaller device, creating a substitute where none was needed (business users would carry their notebook with them anyway), a supplement was built that could do things the PC could not. As we pointed out, the Palm is not an appliance, its integration and ability for co-operation with the PC was one of the key features for its success.

In Need of Consistency?

To enable the combination of minimal patterns, to give the user the freedom of composition, one could ask for internal consistency in Palm applications. Consistency is one of the few things that usability experts will agree on when asked for design values. However, there are some problems with the term: In [8], Grudin makes a case against consistency, stating that a concept without definition is not of much use. He differentiates between three types of consistency (internal, external, familiar features), and carries on to demonstrate that consistency with system architecture (e.g. the file system) may be harmful in interface design. This, however, is the type of consistency that you find most easily in the Palm – the structural minimalism implies a consistency with the system, only here the architecture reflects the design choices, not the other way. With that comes an external inconsistency with both the PC world and the "general purpose device" paradigm, but also an external consistency with users' tasks. Consistency may be a useful term here because it does not imply equal structures in the tasks and the architecture, but rather the existence of a useful mapping (comp. 'Minimal Patterns').

The Palm is also not internally consistent in its interface, it is optimized for quick access and thus every application will behave slightly different. Instead, a key component of the Palm's success was its *compatibility*. Because the exchange of data between standard PC applications and the Palm was so easy, the inconsistencies did not matter.

This is one of the fields where Palm lost its advantage – as other PDAs directly mimic PC calendar tools, the mapping of extended functionality is much easier. And while the ease of handling may decrease, consistency with known applications wins over the compatible, yet partial perspective of the Palm that was adapted to the task.

PLUG & PLAY? EXTENDING MINIMAL FUNCTIONALITY

When the Palm series was a success but the company did not move fast enough, key people at Palm left the company to form HandSpring and take the initial idea to the next level: The SpringBoard was to extend the essential functionality of the Palm where needed, a byproduct of Palm's strategy of supporting only the minimal set of functions and also the beginning of competition with other devices.

This venture, however, proved to be more difficult than expected. Apart from reasons as the difficulty of transforming a software company into a hardware supplier or the limited financial resources, the development of a proprietary slot for seamless plug and play made the hardware expensive, expansions often matching the original device in price. While the initial PalmPilot provided basic functionality for everyone, HandSpring would provide specialized features for those who sought them – too few in the end. Finally, the company was bought again by Palm and hope for Palm's future still relies on their latest development, the integration of mobile phones and the Palm device.

To understand the unsuccessful hardware expansion of the minimal Palm, it might be helpful to look at its successful software counterpart. By giving out a free SDK, Palm encouraged developers to write specialized software for the Palm. Soon, every perceivable function was implemented by some tool. Although this constituted a break with the minimalist principle of the Palm, as much software would do things better done on a PC, and the interface was often less than optimal, the breaking itself was left to the user.

[2] This could also be the information that some information was deleted or changed, the latest change prevails here.

Still, losing the minimal image made the Palm more vulnerable to competition by other general-purpose PDAs.

Usage-Centered & Technology-Driven Innovation

The development of the Palm Pilot was largely carried out using prototyping. Using real or simulated tasks, the functionality was adapted to the tasks, trying to optimize those tasks that were carried out the most often. This use-centered development paradigm resulted in a smooth and intuitive handling. In contrast, PDAs are now developed and sold by the number of features, their innovation has become driven by technology: WLAN and G3 mobile communication connectivity, integrated cameras or voice recorders have become more important that the basic functionality.

Although you can in principle do much more today with your PDA, this proliferation of features has also negative impact on the usability of these devices. It is more difficult to find even simple functions, as complexity increases, uptime decreases, both due to shorter battery life and greater number of programming errors.

From an idealistic minimalist standpoint, one could simply continue developing minimal devices, however a more realistic question is: Is it necessary to join in to sell?

Minimalism and Design

Let's take Apple's iPod as an illustrative example: Renowned for its simplicity and ease of use, the iPod also greatly profits from its visual appearance that more than levels out the advantage other devices may have from announcing a greater range of features. However, even Apple is forced to introduce new features – but this is always done considering the image of the product: reluctantly Apple gave way to the demand for pictures and integrated storage of photographs in the Photo iPod; however, the video player the competition has long integrated was not implemented as the technical insufficiencies endangered the iPods image.

The Battle Rages On

The PDA market is currently an exciting place, with competition from mobile phone companies and major desktop software vendors the direction that development will take is not decided yet. However, there are some hints that convergence of features will not happen. Mobile phone users have problems with menus overloaded with functionality [2]. Many would rather prefer lower connection prices than added value services [1] – a general problem of the technology-driven G3 communication companies. The so-called smartphones have not been very successful so far, possibly because their small size did not allow adequate input for office tasks. Today, the standard equipment – a Bluetooth phone and a notebook – surpass any smartphone in terms of usability.

On the other hand, the success of BlackBerry devices shows that the integration of email into PDAs might have some added value that will convince customers to switch to a new device.

CONCLUSION

It was not font size measured in pixels that won the market for Palm, but the intensive usability testing that gave Palm a better adaptation to users' tasks. The theoretical notion of minimalism can be used to analyze the reductions that were made in the design of the Palm – and to some extent to explain why its concept is challenged today.

Introducing a new computing paradigm with a minimalist device immediately creates the demand of expanding the minimal functionality. This is why the Palm series is losing ground today – even though most people still need only basic functionality. Extending a minimal device is a challenge and whether selective addition of key features can outweigh the marketing power of missing features is yet to be decided. The convergence or diversification in the mobile computing domain remains an interesting subject of study.

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