Beyond WIMP: Designing NUIs to Support Productivity Document Tasks

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Abstract
After decades of WIMP-based computing, a paradigm shift is occurring in the consumer device landscape as touchscreen appliances and applications invade the market. In the professional office world, however, WIMP software still prevails for so-called "productivity" work for lack of adequate modern solutions. In this paper, I argue that for this status quo to start to change, interface designers and engineers need to free themselves from their lingering WIMP influences and think outside the box to create tailored NUIs that fully exploit the potential of the available interaction capabilities of new hardware. In the research community, there are a great number of inspiring approaches that can be built upon to create powerful applications with practical appeal for businesses. I provide a few pointers and suggestions about how this can be achieved, taking the particular case of document authoring as example.

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The Status Quo
The recent boom of NUIs driven by smartphones and tablets have considerably changed the way in which we interact with digital content. A plethora of applications are available on the various app stores of the different vendors supporting a variety of activities. The scope of the majority of these applications and what one can do with them, however, is relatively limited, compared to some desktop programs. In particular, when it comes to professional productivity work, NUIs play a marginal role and most people still resort to regular PCs with keyboards and mice to perform more complex tasks. Documents, around which much office work still revolves, are still created, edited and manipulated using traditional desktop tools. This does not necessarily mean that they are perfect or ideal, however, and indeed there are reasons to believe that interactive sur-

One of the many concepts for future digital office desks with integrated sensing capabilities

A fictional digital desktop used by Dr. Merrick in the 2005 film "The Island"

Perceptive Pixel's Active Stylus pen and touch system [1], bought by Microsoft in 2012

faces can be more suitable platforms for some advanced tasks, including authoring work.

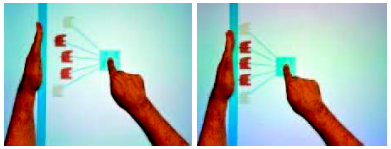
Even though the latest iteration of Microsoft Office follows the new path taken by Windows 8 by adopting touch-friendly components, the interface is still far from having shed its WIMP origins. Part of the reason for that is understandably not wanting to confuse users, most of whom have developed habits with previous versions of the suite. But I contend that there is also a certain lack of boldness among designers of document publishing systems, who have not yet fully considered the breadth of interactive possibilities provided by current surface hardware. In particular, industrial designers still reason in terms of individual finger touches and simple gestures (tap, pinch-spread, swipe etc.), which is overly restrictive. The very recent addition of stylus sensing to multitouch (enabling simultaneous and differentiated pen and touch interaction) in commercial devices has also not yet been followed by viable enterprise products, despite the wide range of interaction possibilities such an input paradigm opens up [3, 4, 6, 8, 10].

In the HCI research community, the picture is somewhat different and examples of creative utilisation of surface computing abound in the literature. The vast majority of the published work, however, focuses on individual interaction techniques and proof-of-concept prototypes that do not necessarily have discernible applicability in real-world workflows *as is,* let alone in office environments. Holistic utilitarian approaches leading to novel but practical systems that demonstrate how to get real work done are rare, and when it comes to sophisticated document creation and manipulation virtually non-existent. That is not to say that nothing that has been proposed so far has practical value and indeed I will show in the next paragraphs that many of those techniques can be adapted and integrated to form the ingredients of a workable document editing system.

The Digital Workdesk

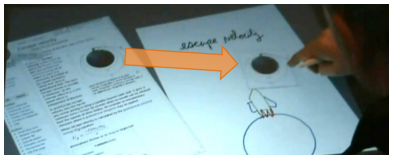
As part of the much touted office of the future the digital workdesk is poised to become one of the essential pieces of equipment of the knowledge worker. The vision is that of a fully interactive surface on which digital content can be manipulated, possibly augmented by supplementary sensors to detect tangibles as well as the surrounding context. In such a configuration, document work can involve physical or virtual objects and often even both at the same time.

Much work has been done on interactive paper and bridging the gap between the analogue and the digital worlds. While interesting, my feeling is that practical concerns still dictate that for complex document tasks and especially for professional document authoring, an integrated all-digital environment is more suitable (for one, it provides immediate feedback), at least for the foreseeable future. Interaction patterns with physical documents, especially using pens, are however too ingrained in people to be ignored. From a UI designer's perspective, it makes sense to seek to take advantage of those behavioural patterns. Moreover, the pen or stylus is still one of the most effective utensils to execute precision or fine-grained operations, such as drawing, lasso selections and handwriting text. A digital surface controlled by pen and touch input therefore seems like an excellent platform to do document work, in particular editing and authoring.



A flat upright hand can be used to create rulers against which objects can be aligned and arranged [9].

A rectangle drawn by the pen in command mode (here activated by three fingers of the NDH maintained on the surface) creates a new document.



Content from other documents can be easily extracted by selecting desired regions with the pen and dragging them over to the edited page [10].

Copies of highlighted text can be easily created with a finger pin + pen drag gesture

Designing a Document Editing NUI

The design of an effective NUI for document composition poses a number of challenges. Depending on how feature-rich the editor should be, those challenges can be more or less easily tackled. An entirely widget-based approach, where each operation would be carried out by activating the appropriate tool would lead to an unnecessarily crowded and cumbersome UI that would not significantly depart from WIMP. But one can also try to be smarter and make better use of the interactive capabilities of the platform, for instance by using gestures (unimanual, bimanual and bimodal when touch is combined with the pen), shape contact triggers or tangibles instead of only one or two fingers. The inherent richness of the input possibilities and combinations thereof enable us to implement an extensive vocabulary of interactions, thanks to which we can have recourse to widgets more sparingly. Hereafter and in the left margin columns I provide a few hints about how some of those "smart" tools could be materialised.

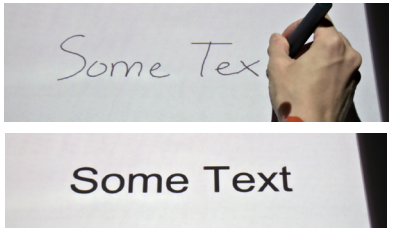
Gesture-based command activation

There are several ways commands can be quickly triggered without requiring the user to tap a button, a menu item or resorting to time-consuming context switches. One possible alternative is to use postures of the non-dominant hand (NDH) to activate functions or constrain the actions of the dominant hand (DH), including and especially if it is holding a pen. Such mode indicators can rely on the number of fingers placed on the surface or particular shape postures (flat palms, fists etc.) to control how the pen interacts with content, e.g. to change the stroke style [7], to constrain object manipulations for increased precision [9] and align or distribute items [5]. The latter techniques can conceivably prove very handy for document layout operations and to arrange content on a page. Furthermore, a command mode activated by the NDH can serve as a basis for the pen-holding NDH to execute gestures that trigger particular actions. For example, striking a line that crosses elements with the pen in command mode deletes those elements; drawing a rectangle on the workspace creates a new page or a new document; tracing a rectangle inside a page creates a placeholder in which content can be inserted (either directly or retrieved using pen-based queries); tracing circles successively in clockwise or counterclockwise directions triggers respectively redo and undo operations; etc.

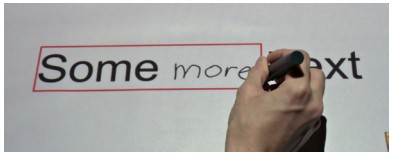
Pen and touch also offers a convenient method to perform copy-paste operations via a finger pin + pen drag gesture [6]. This technique can be utilised at any granularity level, i.e. to duplicate entire documents, individual pages, down to individual document elements, including selected portions of text.

Text Entry

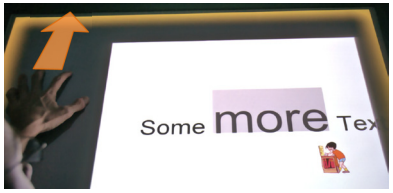
Text input is an essential part of document editing and it needs to be adequately supported. On touch screens it is commonly performed using an onscreen or soft keyboard either by typing the keys directly or by using a shape-writing method such as Swype [2]. The alternative "widget-less" and natural method is handwriting, supported by a reliable recognition engine. While perhaps less efficient than a soft keyboard, handwriting with a pen has the advantage that it is an acquired skill of most literate people and it allows *in situ* text input, i.e. the written content can be directly inked at the desired location. A problem arises however if the handwritten strokes need to be converted in typeset text and formatted as the user writes. Handwritten text is typically larger than print text as the user usually needs



When the user handwrites isolated text, it is converted into typeset text, where the size of the latter roughly matches that of the former. The target style could also be determined by a template.



Text can be added to existing elements by initiating handwriting inside or in the vicinity of the element (if inserted inside, a gap opens to create space). In this case, the converted text adopts the style of the closest character at the insertion point.



An example of how the font size of highlighted text can be modulated using an NDH gesture: here a vertical dragging motion with 4 fingers.

a certain amount of space to write. This problem can be solved through adequate zooming or a large writing area such as a pad. In the left margin column I show a possible solution that uses one or the other alternative, depending on whether the input text is isolated or not.

Regarding text styling, there are some aspects that could be controlled by NDH gestures, such as font size (see left column) and possibly also some typographic formatting such as underlining (a simple line stroke under the text), italic (a quick twitching gesture with a specific number of fingers), bold (a fist or a finger spread) etc. Obviously, the smaller the number of selection options in a particular category the easier it is to map to gestures (and to learn/remember for the user). For style options with a large number of different choices, e.g. font type and colour, however, it is hard to imagine how one can do without some kind of helper tool.

Other Document Elements

Pen and touch tabletop systems do not necessarily lend themselves to all types of documents. Reports, theses, books and similar text-intensive documents are arguably more efficiently authored with a physical keyboard. On the other hand, documents with visual components or structural frameworks such as forms, spreadsheets, charts etc. stand to gain much from a pen and touch-based platform. Imagine a dedicated form design tool with which users can rapidly draw grids, text fields and boxes with the digital pen, assisted by appropriate multitouch actions performed by the NDH. Could that not make an enticing piece of modern office software?

Conclusion

Document engineering involves many complex processes for which interface designers have taken many years to create appropriate WIMP tools. The touch revolution is very recent in comparison and NUIs driving productivity tasks and elaborate document work are still in their infancy. The temptation to reuse legacy UI designs with minor adaptations is strong, but is not necessarily the wisest choice in all cases. Current hardware offers a wealth of interactive possibilities that remain to be properly exploited. I have presented a few avenues I think are worth exploring in order to move forward towards smarter and more effective NUIs for document authoring systems. There is much work to be done.

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