3rd Report for Innovative Interfaces

Robert Hoff

November 7, 2011

1 Context & Comparison

The three papers [11][2][6] are on different topics related to input technologies and techniques.

Until the 80s computer tasks often required low-level knowledge of it's internals, for example, the command line interface was conventionally used for system administration and to run applications. An exception from the low-level interfacing requirements were video-games that had been around since the mid-70s. Schneiderman, in a landmark paper from 1983, introduced the concept of Direct Manipulation [11]. Noting that video games are created for pleasure, but still require the user to accomplish some given task, these games usually drew analogies to existing human skills (pointing, grabbing, moving objects in space), which made the experience with the computer intuitive and satisfying for the user. Direct Manipulation enforces the user's conceptual model, described earlier at Xerox PARC [5], in 1982 the Star Graphics [9] was introduced that uses this paradigm extensively, and today almost all designs adhere to it.

Moving forward to 1993, the paper on Toolglass and Magic Lenses [2] adheres to the principle of Direct Manipulation. By this time GUIs were well established, and tools and conventions were settled almost exclusively on the user input based on keyboard and mouse. This paper was exploring possibilities of engaging the user bi-manually, both hands working together to operate tools and apply commands. Although this particular technology didn't make a future impact, the paper highlighted importance of investigate if there exists benefits by incorporating the user's non-preferred hand more effectively. This is relevant because it was discovered that skilled humans perform tasks using an asymmetric division of labour between their two hands [13]. Previous studies on two-handed input and alternative input devices had shown efficiency gains on navigation and selection tasks [1]. But later studies suggested that conventional devices, such as pointing devices, are not intuitive for humans to be effective as bimanual input [8].

The last paper on Tangible bits [6] may be addressing this problem by introducing a new domain of interaction technology. First defined in 1997 by the same author [7], the idea is essentially to turn everyday objects into potential input devices. The location, orientation, and movement of any object may be taken to have an interpretation by a computer. This would solve the barriers of bimanual input, because human's are already accustomed to working with everyday objects with both hands. A challenge is the ambiguity of the input, such as deciding what sensors to use and how to manage the interpretation. Problems in ubiquitous computing are relevant to this topic because of the potential pervasiveness suggested. Another challenge is how to manage the output to the user, if one uses screens or projectors it may limit applications to physical locations. Wearable, or mobile screens, or augmented reality are additional technologies that may work well with future tangible bits.

2 Summaries & Discussion

2.1 Direct Manipulation: A Step Beyond Programming Languages

The landmark paper from 1983 defines direct manipulation, by surveying existing technologies and making some observations. Users report good experiences with a few programs at the time, for example video games, and some other graphically enabled applications. This attraction to games contrasted with anxiety users experienced towards contemporary office applications. In latter type of applications, the user typically needed low-level knowledge of how a computer operated and may have had to use a command line interface to execute a string of commands to achieve basic tasks such as running an application. In games the user is abstract from a log-level program domain, to a higher-level problem domain, error messages were for instance unnecessary because the result of all actions were fully contained. The most important features observed that made interaction with computers pleasurable were essentially to have visibility and representation of objects of interest (objects are often metaphores in aiding tasks), and use of direct and intuitive methods of interaction.

The evaluation suggests that direct manipulation techniques could be employed to solve virtually any computer based tasks. The disadvantages pointed to are they may be hard to program and require graphical displays and pointing devices. But these are largely solved today. Examples of alternative paradigms of operation are menu selection, form filling and command language, although these may be efficient and powerful are usually not intuitive and requires training to use. Direct manipulation changes the perception of a device and keeps the complexity of a PC down to a managable level for non-technical users, which is probably the reason why virtually all modern programs use direct manipulation methods today.

2.2 Toolglass and Magic Lenses: The See-Through Interface

The paper [2] introduces two innovations. The toolglass, a transparent and movable set of click-through tools, and magic-lenses, a type of see-through filter used for observing graphical transformations. In the paper graphical editing software, and visualisations (e.g. scientific) are considered. But a range of potential applications are suggested, such as spreadsheets, word processors, and others.

The paper is interesting both for it's invention of the new types of application tools, (the *toolglass* and *magic lenses*), and secondly for the motivation for building these tools, which was to explore potential benefits of bimanual input.

Conventionally at the time (1993), and is still the convention today, most of the user input in graphical editing environments is done with the user's preferred hand, by using the mouse. The toolglass and magic-lens tools encourages the use of the user's non-preferred hand.

In my opinion, the system suffers from issues of complexity. The click-through tools and viewing filters are not intuitive (in particular don't observe the rules observed in the paper of direct manipulation, and may not support the user's conceptual model). The amount of tools may be too feature rich, and in danger of cluttering the screen. The viewing filters may make it difficult for the user to know the difference between changes that have been applied permanently, and others that are only previews. However the innovations presented offer a new design space for user interfaces, and it's important research to investigate benefits of bi-manual input Recent research is considering bi-manual touch-screen devices [4]. Bi-manual input may be more relevant for future alternative technologies such as the next paper on tangible bits.

2.3 Tangible Bits: Beyond Pixels

Tangible bits was defined in an important paper in 1997 at the MIT Media Lab [7]. This paper by the same author [6] is a survey of the topic. Physical represenations are explicit and understandable. Some everyday items may correspond to objects that were previously used as metaphores, such as a real pencil or eraser. Another example are active badges, can sense when a user enters a room, which can trigger the loading of a personal environment. The interactions with physical objects are in harmony with existing human skills, which may reduce the need for training. Physical objects are also persistent and pervasive, so the topic touches on issues of ubiquitous computing and augmented reality, the development vision is to embed sensing technology into the environment, turning everyday objects into potential interfaces [3]. Input and output merges, and feedback is intended to blend and augment ones environment, physical feedback is considered in some systems.

The DigitalDesk did had similar considerations earlier using common objects such as papers and books as input [12] and projection for augmentation. A few future applications. Interactive tabletops, use objects with fiduciaries and feedback by projection. A compelling example is reacTable [10]. Tangible telepresence is the ability to synchronise remote physical configurations. Augmented reality, entire environment is a domain of interaction and input, feedback is supplied by overlaying additional images on visual field.

References

[1] Buxton B. and et al. A study in two handed input. *Proceedings of the SIGCHI conference on Human factors in computing systems*, 1986.

[2] A.E. Bier, M.C. Stone, and et al. Toolglass and magic lenses: The see-through interface. *Proceedings of the 20th annual conference on Computer graphics and interactive techniques*, 1993.

[3] Abowd G. and Mynatt E. Charting past, present, and future research in ubiquitous computing. *ACM Transactions on Computer-Human Interaction*, 2000.

[4] Benko H., Wilson A.D., and Baudisc P. Precise selection techniques for multi-touch screens. *SIGCHI conference on Human Factors in computing*, 2006.

[5] C. Irby and et al. A methodology for user interface design. 1977.

[6] H. Ishii. Tangible bits: Beyond pixels. *Proceedings of the 2nd international conference on Tangible and embedded interaction*, 2008.

[7] H. Ishii and B. Ullmer. Tangible bits: Towards seamless interfaces between people, bits and atoms. *Proc. CHI, ACM Press*, 1997.

[8] Hinckley K., Czerwinski M., and Sinclai M. Interaction and modeling techniques for desktop two-handed input. 1998.

[9] D.R. Lipkie and et al. Star graphics: An object-oriented implementation. *SIGGRAPH '82*, 1982.

[10] Jorda S. and et al. The reactable: exploring the synergy between live music performance and tabletop tangible interfaces. *1st international conference on Tangible and embedded interaction*, 2007.

[11] B. Shneiderman. Direct manipulation: A step beyond programming languages. *IEEE Computer 9,4*, pages 57–69, Aug. 1983.

[12] P. Wellner. Interacting with paper on the digitaldesk. *Communications of the ACM*, 1993.

[13] Guiard Y. Asymmetric division of labor in human skilled bimanual action: The kinematic chain as a model. *Journal of motor behavior*, 1987.