The Practicality of Organic User Interfaces

A closer look at why we are shifting away from rigid computing interfaces back to tangible, organic interfaces.

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Introduction

This paper starts out with an investigation of what organic user interfaces are, explores the technology that makes them possible, and discusses the challenges associated with them. However, just because technology makes the organic interface possible doesn't mean the push to implement them is a practical one. So this paper also seeks to explain ***why*** designers are exploring organic interfaces and to answer the question: are they practical?

Definition

It is considered to be a more natural, or "organic", experience when information is communicated to us through normal everyday objects instead of through words and graphics on a computer screen and so designers have begun trying to achieve this organic effect by incorporating digital properties into everyday objects in our environment (Schwesig, 2008). With an organic user interface (OUI), the input and output devices are largely one and the same – the interface itself – rather than being separate devices, as with a keyboard and screen. An OUI is typically non-planar and is operated by touch and gestures and, in the case of the flexible OUI, the interface itself is actual data that is controlled through manual deformation. (Holman & Vertegaal, 2008)

By moving away from the planar rigidity of the LCD screen and keyboard, organic interfaces broaden the scope of affordances currently offered by computers (Holman & Vertegaal, 2008). The concept of human-computer interaction is also broadened to include not just humans and computers but also the physical world. Temperature, air, light and other such physical phenomenon are brought into the mix as valid ways of interacting with computers and manipulating data (Rekimoto, 2008).

When developing an interface that is truly organic, designers should stick to these three principles: 1) Input Equals Output – this principle states that in organic interface design, the input and output devices are merged into one, contrary to current point-and-click planar systems where the input and output devices are separate; 2) Form Equals Function – this principle states that displays can be of any shape and designers should be careful to closely match the display's shape with the functionality of its graphics; and 3) Form Follows Function – this principle states that a display's shape should not be static but should be changeable with the ability to dynamically adapt to the flow of its usage (Vertegaal & Poupyrev, 2008).

Technology

A number of new technologies have emerged and combined to advance the development of organic interfaces. Electronic ink (E-ink) is a technology where thousands of positively- and negatively-charged particles suspended in a clear liquid are rendered either black or white when a positive or negative electric field is applied. Once rendered black or white, the particles remain that way without any further application of energy (Co & Pashenkov, 2008). Organic light-emitting diode (OLED) technology uses both emissive and conductive layers of organic molecules that light up when electricity is applied. The flexible version of the OLED – called the FOLED – has been combined with super-thin flexible batteries and other flexible electronic components (like sensors and circuits) to create the concept of the Gummi interface – a flexible, credit card-sized interface that responds to pressure (Schwesig, 2008). New innovations in sensing technology enable the detection of pressure, acceleration and multi-fingered touch on any surface while advances in shape memory polymers, ultrasound motors and actuating devices enable displays to automatically reshape based on input (Vertegaal & Poupyrev, 2008).

Existing technologies have also proven useful in advancing organic interface design. Electroluminescent lighting (EL) places a phosphor layer inside two conductive layers to create thin, bendable lamps. These lamps light up through the application of alternating electrical currents. In addition, optical fibers reconfigured to emit light along the side of the fiber rather than inside its core can be combined with light sources to create a flexible source of light. Even traditional LED lights, because of their small size, can be rendered flexible when applied to a bendable material (Co & Pashenkov, 2008).

In all of the above examples, it's not the technology alone that advances organic interface development but how these technologies are incorporated into existing flexible materials such as paper or fabric. OUI development then becomes "as much a matter of process innovation and materials research as it is a question of electrical or computer engineering" (Co & Pashenkov, 2008, p. 45).

Practicality

Besides being able to have beverage cans that show ads and videos (the Dynacan), rain jackets that light up in response to rain drops (the Puddlejumper), and pressure-sensitive ping-pong tables (the Ping Pong Plus), is there a strong enough need for flexible interfaces? Is the move towards bendable, shape-changing display interfaces a practical one? After all, if technology moved away from paper because of its limitations – many of which are related to its deformability – why the shift back to paper-like deformability?

One case for the natural, organic interface is that it enables us to suspend our disbelief in the same way we might when watching a really good film in a movie theater (Schwesig, 2008). We forget the technology and get caught up in the experience. And while there can be practical applications of this, such as with medical and military training, most current applications seem to revolve around fun products that exploit the "cool" factor.

Yet, there may be strong, convincing reasons for using flexible displays. For example, there's no doubt that the manipulation of the type of curved data sets used in 3D and geographic models would be improved through the use of curved input and output devices. In fact, many everyday tasks are made easier through deformability – storing objects, flipping pages to navigate a document, and being able to change functionality based on context (for example, a shirt can change shape in order to carry something). Those are examples of practical uses of an object's flexible properties and are not easily duplicated with a mouse, an LCD screen, or an e-book. So while the traditional, rigid computer has given us speed of computation and better long-term storage of data, other real-world functionality is lost. A piece of paper can communicate information while at the same time be wrapped around an object or folded into a shape that may convey additional meaning – not so with a Blackberry device (Holman & Vertegaal, 2008). And although a computer mouse is a great example of how data manipulation can go from being abstract to being very tangible and physical via the tight coupling of analog input with responsive graphics, it can never take advantage of the full range of human manipulative abilities because of its limited positional control (Rekimoto, 2008).

Fashion designers and architects have long been able to exploit the deformability of their materials in their designs, opening up additional degrees of freedom and affordances not available to designers in the computer field. Deformability is actually seen as a desirable property directly related to ease of use (Gallant, Seniuk, & Vertegaal, 2008). It is also thought that if computing devices were made flexible and malleable that would naturally lead to them being more ergonomic thus supporting our well-being (Holman & Vertegaal, 2008).

Sustainability is also seen as a major advantage of organic interfaces. For instance, due to the bi-stable nature of E-ink particles (once rendered black or white, they stay that way), no energy is required to read an E-ink display. Digital paper that can be automatically updated reduces the need for printing and re-printing (Blevis, 2008). In fact, the unbelievably wasteful aspect of the brochure industry led one group of researchers to explore the development of a flexible organic display that would mimic the functions of a tourist's brochure but would be easily updatable and reusable (Toh et al., 2009).

Challenges

Despite the advances in OUI development, there are many challenges to overcome before organic interfaces can become a widespread reality. The cost of the technology is still high. For instance, there's currently no way to detect surface deformations that is both inexpensive and reliably consistent. Innovations such as the flexible Paperwindows and Gummi displays are made effective only through the use of expensive motion capture devices or throwaway hardware prototypes (Gallant et al., 2008). In the case of organic interfaces that try to mimic paper, the text must be of equal or better quality than paper, and the display must be as portable, aesthetically authentic and easy to use as ordinary paper (Blevis, 2008) before widespread usage and acceptance can be expected. In cases where displays change shape or the data is spread across different disconnected contexts, it’s difficult to maintain consistency across all the various forms and contexts. OUI designers will need to resist the urge to take a one-size-fits-all approach to their flexible displays (Holman & Vertegaal, 2008). There are even challenges to making sure organic interface designers do not make the claim of sustainability while actually encouraging unsustainable behaviors. For example, cheap and ubiquitous little displays can be beneficial if the end result is the easy upgrade of the devices that contain them. However, if the result is that devices end up becoming more disposable because the displays quickly become obsolete, then nothing has been gained and quite possibly more environmental damage has been done (Blevis, 2008).

Conclusion

The initial shift away from paper as a means of storing and communicating information can be seen as being directly related to some its flexible properties – paper is easy to permanently damage and destroy and it can be deformed to the point where its contents are unusable. Computers have proven to be much more functional in terms of mass and timely communication because the data doesn’t have to abide by some of the more limiting laws of physics (Rekimoto, 2008). So why the shift back to flexible, even foldable, surfaces as a means of communication? I see this shift as a way to take advantage of the advances in computing technology while still retaining the positive aspects of flexible materials that were lost in the move to rigid computing devices. For instance, portability, adaptability and ease of use are all still very desirable traits of flexible surfaces. The combination of E-ink, OLEDs, and flexible electronics applied to pliable, organic surfaces prove that we may not need to lose those traits. Organic interfaces combine the best properties of the computing world with those of the natural, physical world. Moreover, unlike with paper, when a flexible interface is destroyed or damaged, the information contained on it need not be. If implemented correctly, OUIs may prove to be a practical upgrade of paper.

References

Blevis, E. (2008). Sustainability implications of organic use interface technologies: an inky problem. *Communications of the ACM*, *51*(6), 56-57.

Co, E., & Pashenkov, N. (2008). Emerging display technologies for organic user interfaces. *Communications of the ACM*, *51*(6), 45-47.

Gallant, D., Seniuk, A., & Vertegaal, R. (2008). Towards more paper-like input: flexible input devices for foldable interaction styles. *Symposium on User Interface Software and Technology*, 283-286.

Holman, D., & Vertegaal, R. (2008). Organic user interfaces: designing computers in any way, shape or form. *Communications of the ACM*, *51*(6), 48-55.

Rekimoto, J. (2008). Organic interaction technologies: from stone to skin. *Communications of the ACM*, *51*(6), 38-44

Schwesig, C. (2008). What makes an interface feel organic? *Communications of the ACM*, *51*(6), 67-69.

Toh, Y., Kang, D., Jeung, J., Pan, Y., Bhang, S., Baik, S., Park, S., Kim, J., Chang, M., & Kim, K. (2009). Green-i: an interactive reusable brochure paper for eco-touring. *International Conference on Computer Graphics and Interactive Techniques*, *4*.

Vertegaal, R., & Poupyrev, I. (2008). Introduction. *Communications of the ACM*, *51*(6), 26-30.