Towards a Taxonomy of Interaction Techniques for Ephemeral User Interfaces

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Abstract

In this paper we look at interaction techniques for ephemeral user interfaces (UIs). Ephemeral UIs form a class of user interfaces that contain at least one UI element that is intentionally created to last for a limited time only and typically incorporates materials that evoke a rich and multisensory perception, such as water, fire, soap bubbles or plants. When used for input and output, these mostly natural materials give displays new shapes, come with a variety of specific properties and semantics, and at the same time naturally offer a wealth of interaction techniques that are beyond what typical UIs nowadays realize. Within art, interaction design research and DIY maker communities many prototypes of ephemeral user interfaces can be found. By bringing together and analyzing this wealth of display materials and interaction styles from a material perspective, our work contributes to envisioning future interactive surfaces that will next to "traditional" and natural materials as well include novel and smart materials.

Keywords

Interactive surface, tangible user interface, ephemeral user interface, materiality, ephemerality, interaction

materials, soap bubbles, water, ice, fog, plants, food, fire, sand, clay, air, smart materials.

ACM Classification Keywords

H.5.2 Information interfaces and presentation (e.g., HCI): User Interfaces – *Input devices and strategies, Interaction Styles.*

General Terms

Design; Human Factors.

Introduction

Displays could take many shapes, and as discussed by visions such as "organic user interfaces" [5] or "radical atoms" [6] dominating displays in their current form are quite limited regarding material diversity, the meaning of their shapes in relation to the content, the evoked touch-experience or the offered interaction styles. In order to broaden our view and to discuss the potential diversity of future interactive displays, we looked at user interfaces that incorporate natural materials like plants, water, sand, air or food. From a user experience perspective, natural materials have many characteristics, which are difficult or cumbersome and sometimes even impossible to achieve with other materials. These natural materials often come with a wealth of characteristics: they naturally influence the shape of a display; they privilege certain interaction techniques and eliminate others, and they even can influence how long a user interface lasts. Starting from this last aspect, we characterized the term "ephemeral user interface" [4] and analyzed the offered interaction techniques from a material perspective based on a literature and video review and own experience of prototypes from art, interaction design research and DIY maker communities. In the following, we will first give a brief introduction to ephemeral user interfaces and then outline how the interaction space of ephemeral UIs can be structured. Based on this, we present a collection of interaction techniques according to the interaction material's state of matter: gas, liquid, or solid. The paper ends with a short discussion how our insights can be applied to future interactive surfaces.

Characteristics of Ephemeral User Interfaces

Ephemerality (i.e. transience; from Greek "ephémeros", literally: "lasting one day") is an important concept in humans' lives and their surrounding. Humans perceive many things as well as events as ephemeral, which give them meaning and turn them into aesthetical experiences [2]. We are especially interesting in bringing this concept of ephemerality into human-computer interaction (HCI) and discuss it from a material perspective. We introduced "Ephemeral User Interfaces" in [4] as follows:

"Ephemeral user interfaces are a class of user interfaces that contain at least one UI element that is intentionally created to last for a limited time only. The durability of the UI element is determined by its intrinsic material properties in combination with its surrounding ecosystem. While their ephemeral UI element(s) exist(s), ephemeral user interfaces provide a rich and multisensory user experience. They may deliberately be designed to offer only partial or imperfect user control." [4:3]

Examples for materials for ephemeral user interfaces are many natural materials like the elements water, air, earth and fire (for examples for ephemeral UIs see figure 1). In the following, we specifically want to look at interaction techniques used within ephemeral user interfaces.

Interaction with Ephemeral User Interfaces

In order to structure ephemeral user interfaces we started from the main materials' state of matters: solid, liquid and gas. We applied these from a user perception perspective rather than from a strict chemical point of view. In ephemeral UIs, ephemeral materials can be used for output only, for input only or for input and output at once. For example prototypes for all classes see figure 1. The optimal ephemeral user interface integrates input and output such that a direct interaction in one interaction space is realized (figure 1 column 3). Starting from this taxonomy and focusing on ephemeral materials for input as well as input and output, we can further examine the applied interaction techniques.

As other authors have stated (c.f. [13]), there are many more ways to touch surfaces than commonly are sensed in current user interfaces. Starting UI design from a material perspective naturally leads to richer interaction styles, as the material's properties and semantics guide how we touch a surface and how we interact with an artifact. We collected interaction techniques from 50 ephemeral user interfaces and clustered them based on the interaction material's state of matter and its perceived form (see figure 2 for examples). This collection builds an inspiring basis to discuss future interaction techniques suitable for specific materials, user groups and application contexts.

Discussion and Conclusion

We have looked at a variety of different displays from a material perspective, focusing on ephemeral user interfaces and natural materials for interaction. For the research and development of future displays we think this

Figure 1: A Taxonomy of Ephemeral Materials for Interaction.

	Ephemeral Materials for Output only (Indirect Interaction)	Ephemeral Materials for Input only (Indirect Interaction)	Ephemeral Materials for Input and Output (Direct Interaction)
Solid	Plant Display [7]	Noisy Jelly [9]	Ice Wall [17]
Liquid	Water Games [8]	Water Interface for VR [3]	Soap Bubble Interface [15]
Gas	Murmur [12]	Thanato Fenestra [16]	Interactive FogScreen [11]

Figure 2: Examples for Interaction Techniques clustered by the Interaction Material's State of Matter.

State of Matter	Perceived Form	Example Interaction Materials	Example Interaction Techniques
Solid	stiff	ice	(multi-)touch gestures [17]
	particles	sand	digging hands into sand [14]
	malleable	plants, jelly	touching, sliding fingers [10] touching, stroking, rubbing [9]
Liquid	shape determined by container	water	full body interaction: moving in circles around fountain [8]
	sphere	soapbubbles	touching + moving, blowing, waving [15]
Gas	transparent	air	clapping, yelling [12]
	opaque	fog	walking-through, mid-air gestures [11]
	combustion	fire	lighting a candle, blowing, waving [16]

work contributes threefold: first, by bringing together and analyzing the diverse field of natural materials as part of interactive displays; second, by collecting, structuring and understanding the wealth of interaction techniques often naturally afforded and offered by the used materials; third, by using the gained insights regarding material properties and semantics for interaction as inspiration for novel and smart materials for interactive displays. Overall, we think its valuable to look at displays and interaction techniques from a material perspective and to contribute this way to a material knowledge for interaction design, similar to Ashby's and Johnson's compilation of approaches for material selection in product design [1].

Acknowledgments

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