You move, you move me: Exploring Lifelikeness in Deformable Interfaces

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Abstract
When inanimate objects start moving on their own, humans often attribute life or lifelike qualities to the objects. In this paper we discuss lifelikeness in deformable interfaces and suggest future research to help us understand better when and why lifelikeness is appropriate.

Author Keywords
Deformable Interfaces; shape-changing interfaces; organic user interfaces; actuated interfaces

ACM Classification Keywords
H.5.m [Information interfaces and presentation (e.g., HCI)]: User Interfaces – Haptic I/O, Input Devices and strategies, Interaction styles.

General Terms
Human Factors

Introduction
A recent trend in HCI is to create deformable interfaces that can change their own shape. Examples include a water faucet that changes posture to raise awareness about water consumption [10] and actuated tabletop displays, which are able to render three-dimensional shapes [6, 5].

When inanimate objects start moving on their own, humans often attribute life or lifelike qualities to the objects. This phenomenon is known as *antromorphism* or *animism* and forms the basis of classic animation [9]. Pixar's Luxo Jr. (Figure 1) exemplifies the power of the kinetic vocabulary of animation. Even though Luxo Jr. is just a regular anglepoise lamp, we feel his exuberance as he plays with the ball and find him immediately likeable.

In this paper we discuss lifelikeness in deformable interfaces and suggest future research to help us understand better when and why lifelikeness is appropriate.

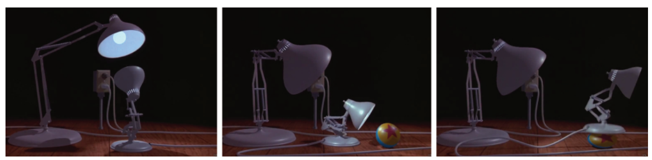

Figure 1: Frames from Pixar's Luxo Jr. that demonstrate animism. When Luxo Jr. starts moving, we attribute life to it.

Lifelikeness in shape-changing interfaces

Several research projects in the area of shape-changing interfaces have sought to make use of animation to communicate information to users through lifelike movements; Rasmussen et al. [7] and Schmitz [8] offer extensive reviews. For example, Toggler et al. [10] created the Thrifty Faucet that communicates information on water consumption and hygiene to users through deforming its shape into various postures. If users forget to wash their hands, the Thrifty Faucet will stretch towards them to invite them to turn it on. In contrast, if users use too much water, the faucet will curl up to signal rejection.

Figure 2: The thrifty faucet in three postures: (a) seeking, (b) curious, and (c) rejecting.

Another example of a "living" interface is the inflatable mouse by Kim et al. [3]. The Inflatable Mouse creates tension by mimicking a heavily pumping heart (Figure 3ab) or calmness by simulating the "motion of taking a nap when it is not in use." [3] (Figure 3c).

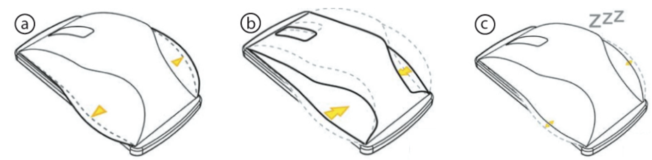

Figure 3: The inflatable mouse uses lifelike movement: (a, b) a heavily pumping heart, and (c) simulating taking a nap.

Lifelikeness in deformable surfaces

Several deformable surfaces simulate life in a similar fashion. Most notably is MoleBot by Lee et al. [4]. This research project aimed to bring life to screens by creating the illusion of a mole that lives underneath a tabletop and projects its presence by deforming the surface (Figure 4a). Users can interact with the mole through gestures and the mole moves around the table and interact with the physical objects on the table (e.g., pushing over a coffee cup).

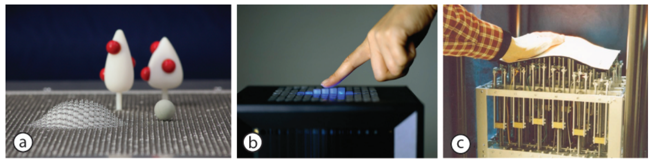

Figure 4: Three deformable surfaces: (a) Molebot, (b) Lumen, and (c) FEELEX.

Similarly, Poupyrev et al. [6] created Lumen (Figure 4b), an interactive display that presents both visual images and physical, moving shapes. The motions are described as smooth and continuous and serve to provide aesthetically pleasing, calm animations. With the Feelex project, Iwata et al. [2] explored using deformable surfaces for providing haptic feedback. They created an interactive Anomalocaris (a pre-historic creature) that appears to be in motion depending on the force applied by the user. If the user pushes its head, it reacts angrily and struggles.

The deformable surfaces all seek to extend the expressiveness of interfaces beyond that of traditional static surfaces. For instance, FEELEX [2] aims to "present deformable objects, just like living creatures" and Lumen seeks to deliver "slow, organic animations, creating calm, emotionally pleasing shapes." [6].

Discussion

In the following we discuss three research questions that emerged from the presented literature.

First, very few of the papers investigate how deformations are perceived by the users. One exception is the Thrifty Faucet, and here the deformations triggered emotions ranging from fright to amusement [10]. It is thus unclear whether the designer's conceptual model is in agreement with what is being experienced by the user. We suggest future research to put more emphasis on user studies in order to investigate if the many emotions and expressions intended by the designers will materialize in studies or in real use. Whereas lifelikeness is an attractive goal, the Thrifty Faucet suggests that it may perceived contrary to designers' intentions.

Second, we suggest future research to systematically explore the kinetic vocabulary of deformable surfaces and how this may be used. In the field of shape-changing interfaces, Rasmussen et al. [7] recently investigated the different types of change in shape that is utilized in the literature and found that little is known about how the different types of shape-change contribute to the overall user experience. As an analogy, Harrison et al. [1] used a crowd-sourced study to gather thousands of judgements to investigate the expressivity of point lights (i.e., LEDs). 265 participants were presented with videos of different light patterns and asked to rate how well the patterns conveyed different types of information content. Similarly, we believe it would be highly valuable to see in-depth studies of the expressivity of different types of movement in deformable surfaces.

Finally, we suggest future research to discuss the suitability of deformable surfaces in different contexts. Currently, the research in deformable surfaces is focused primarily on overcoming the technological challenge of making surfaces deform. While this might be appropriate for an emerging field in its early stage, we believe it is important at the same time to discuss when and why deformation is preferred over other output modalities.

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