
The Perceptual Cloud

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Abstract

In this position paper we argue that the decoupling of the computational and the interaction substrates leads to a new paradigm of human-computer interaction in public spaces, which, insofar, has only been part of Science Fiction and new media artworks. This new paradigm will have a tremendous impact not only on what users assume and expect from computational interactive systems, but also on everyday life and its concerns, especially privacy, image ownership, perceptual ownership.

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ACM Classification Keywords

H.5.0. Information interfaces and presentation (e.g., HCI): General.

Screens, screens everywhere

Screens have become an integral part of the human experience. With at least a 75% of the world population with access to a cell phone [10], people naturally introduce screens in every aspect of their everyday life. With the addition of cameras and touch surfaces to almost every screen-based device, screens are now bi-directional communication devices. They are not only devices to be looked at, but also devices that look back at us.

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This, as often is the case, has been made explicit by new media artists, even to the point that “magic mirrors” have become a gesture, or cliché, or design pattern in new media art (it has been said that mirrors were the first interactive art pieces).

Even more notable is that we are training these devices not only to look back at us, but also to “understand” us in a similar, or coherent, way with how we perceive and understand the world and ourselves. Devices that recognize faces, infer emotions, body postures, and gestures are present in a wide range of devices, from photo cameras to video games and TVs.

The bi-directionality of the screen is ubiquitous, and the difference between sensing and showing information is blurring, not only by the extremely frequent camera-screen pairing but also with the introduction of sensing pixels, Wedge-like devices [8], and touchscreens.

Privacy, surveillance, and big brother concerns are common themes in the media arts, as art many times takes as its duty to reflect on new concerns.

As Christian Paul states: *“technologies often tend to develop faster than the rhetoric evaluating them, and we are still in the process of developing description for arts using digital technology as a medium—in social, economic, aesthetic respects.”* [5]

Decoupling

A parallel trend –which can be somewhat seen as a wink to the mainframe paradigm of earlier computing days– has been recently dubbed “cloud computing”, where different operators can provide almost everything “as a service”. Definitions of what is

currently offered as a service overlap and comprise, among others, infrastructure as a service, platform as a service, storage as a service, software as a service, data and databases as services, and testing as a service.

The “cloud” should not be understood only as the remote use of computing power, data storage or another infrastructure, but also as the effective decoupling of the computing power (in its broader sense) from its human interface.

Although remote storage and remote computing have been present for a long time in computer history, its seamless, transparent, or invisible integration into mobile devices is very new. Apple’s Siri service for their iPhone smartphone remains one of the most used and relevant examples. Siri (which stands for “Speech Interpretation and Recognition Interface”) offers a versatile natural language interface capable of understanding many basic phrases and to reply in a spoken voice. What is remarkable is that this interaction is performed by a mobile device that uses Apple’s servers to process the audio (and store it, which should rise a great concern for the users’ privacy¹).

This decoupling of the processing and the interface is invisible to the user (unless the user has limited or no connectivity, in which case the service does not run). The phone acts as an interface for a remote computing

¹ IBM forbid its employees to use the feature, as reported in <http://www.technologyreview.com/news/427790/ibm-faces-the-perils-of-bring-your-own-device/>

service but, for the user, it is the device that performs the operation.

A second decoupling of the computing and interaction layers has received many names and has seen many incarnations. At University of Tokyo, Cassinelli's team coined the phrase "invoked computing" for one instance of such decoupling [11]. They propose to empower the users with the ability of *invoke* computing behaviour onto any physical device (they showcase this with a pizza box acting as a laptop computer and a banana acting as a telephone). This is accomplished by using image projectors converting any reflecting surface into a screen, and parameter speakers using ultrasound to "project" sound into any object.

Other examples of this with steerable projectors that can point to arbitrary spaces can be found in our own Mapinect [4], and in Microsoft Research's Beamatron [9].

As Cassinelli's points, when introducing Invoked Computing, "the most challenging part of this proposal is the automatic detection of suggested affordances." Although this can be side-stepped by users learning a set of command gestures, or by presenting users with, for example, projected touchable menus, the "magical" augmented reality-like properties that Cassinelli et al.'s propose do require the automatic correct interpretation of the invoker object's affordances.

The perceptual cloud

Even if both mentioned decoupling strategies are not entirely new, their combination is not only novel, but also it will have a profound impact on everyday life and on how we conceptualize computers and their use.

The future scenario is this: every surface within every object everywhere is a potential interaction device or part of an interaction device. Every surface is a screen, every object a speaker. Every suggested, metaphorical, affordance of every object is real. Every user movement, every gesture, every spoken word is analysed, is reacted-to, and possibly recorded.

Even if we do not know the exact implementation of this radical transformation of the environment, we are confident in its unavoidable advent. The required ubiquitous sensing and audiovisual projection will probably be achieved by a combination of in-situ devices (projectors, parametrical speakers, etc.) and wearable appliances (in the styles of MIT's 6th-sense [3] or Google's Project Glass [6]).

It is the double decoupling of the *perceived* interface support from the actual interactive device, and the perceived computing support from the actual computing device what will allow for this radical transformation of everything everywhere.

In this paper, we name this the *Perceptual Cloud*.

Art in the Perceptual Cloud

There are many objections to the idea of a perfect choreographed Perceptual Cloud, and the ways that companies will steer towards their most profitable future is yet to be seen, but, regardless the implementation details, a version of it will certainly happen, and it will constitute a fertile field for artistic expression and reflection.

Street and Public Art are not only old ideas, but also conform a legitimized artistic area, with, for example,

Los Angeles's MOCA having run a major exhibit on Street Art in 2011.

Even if we still do not know what art in the Perceptual Cloud will be, there are a number of common themes that will not only translate onto the Perceptual Cloud, but also their concerns and interests will be amplified by it.

What artists have to say about privacy, visual pollution, and control in the Perceptual Cloud era? It is indeed easy to think of a mash-up of ad-blocking software and Julian Oliver's *The Artvertiser* [7], but in a realm where everything can display information, see us, and react to us, this approach appears somewhat naïve.

Quoting Gärdenfors: "As the number of screens around us grows, the way information is designed will need to change. With each individual screen trying to grab our attention, we might respond by learning to ignore them to avoid information overload. To counter this possibility, could we imagine new and complex screen arrangements that act to our advantage by addressing real and immediate needs?" [2]

The same translation applies to privacy and surveillance. How artists will react to our exacerbated Orwellian future?

The opportunities the Perceptual Cloud offers are immense. Besides collaboration and delegation being taken to new levels, a new type of artworks might arise.

The creation of awe has been one of the main aesthetic objectives of new media art, yet, with the normalization of the interactive technologies, the medium of interactive digital arts is reaching a new state of maturity where the immediate reflex of showcasing a

new way of capturing users input or to display information will not longer be active.

In the Perceptual Cloud, the ideas of screen, interaction, devices, and affordances will be malleable. (The dish where you eat reminds you of a steering wheel? Well, then it *is* one). The embodiment opportunity that Natural User Interaction offered media artists has to be re-situated into a reality where everything can embody anything in a way that it is natural and transparent for every user.

Yet, it is the concept of a malleable notion of interaction is what offers the widest opportunities. For interacting with computers (in the most general sense) will not be anymore defined by any pre-conceived set of gestures, interfaces, devices, or reactions.

Although nonspecificity was the "curse and opportunity of computer art" where "everything is possible but nothing is necessary" [1] an artistic language of computer art has been created. This is about to change. In the Perceptual Cloud the pre-conceived ideas of computer representation and interaction are to be expanded and radically changed.

The very human universe will be expanded, and it is for the artists, again, to find the necessary.

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