HCI Essay - Human computer confluence - Michael Persson

Introduction

Half a year ago, I bought an Ipad. No matter where I go now, I bring it with me. Visiting my parents in the countryside? Yep. Taking notes or drawing at lectures? Sure. Game night at the local hobby store, travelling by bus, or even going to the bathroom? No problem. With this modest computational device, the physical husk of my globe-spanning digital presence is no longer tethered to the metaphorical ball and chain of a computer desk, nor to an unwieldy laptop. I know that this portable technology is not brand new, and I'm probably a few years late to the party, but even so I feel that contemporary HCI is just scraping the surface of the potential that lies within a digital presence free from the boundaries of physical location. It also seems to me that we've only recently reached the level of technology to realistically facilitate a large-scale blending of computers with ourselves and our environment. For example, the presence of smart phones have been steadily increasing over the last few years, and for the first time in human history everyday people are, perhaps unwittingly, carrying an advanced computer with them at all times. Following this trend of technological and social evolution, what can we expect to see in the future?

Precipice of ubiquity

In the japanese animation Dennou Coil (2007) we learn about the everyday life and implications of living in a society where the real world is just half of the equation. Within the premises of the physical realm is contained a digital world, viewable through computerized spectacles, inhabited by interactive agents such as digital pets. At first it sounds very futuristic, but many of these themes are already present in the contemporary. The to me most obvious example of this theme is geocaching, where a player sets out to find a GPS coordinate with the help of a mobile phone, and having done so, solves a task in the physical world. Another, less commercially available example, is the upcoming Google Glass, which is basically a monitor implemented into a pair of glasses - a wearable computer.
I believe that a lot of people are unaware of the fact that we are already surrounded by a digital world, but the ether is saturated with information - we just have very limited ways of interpreting the data. Sure, we can access the information through physical viewports - mobile phones, computer monitors, tablets - but the bulk of it isn't in any way spatially relevant. If there was a way to solidify the connection between physical location and digital data, we could navigate the digital information space in the same fashion as we navigate the physical space.

Concept

For the future of augmented reality and ubiquitous computing, I imagine a highly malleable digital canvas on top of constraints anchored in physical reality. The technology doesn't need to be physically implemented in situ since the overlay is completely digital, with the users physical location being coincided in a pre-created digital world. Imagine a massively multiplayer online game (MMO), only with the digital world being a representation of the real world, and your avatar being represented by your physical body. There will be varying degrees of transparency

between the real world and the digital world depending on the activity context - if you're doing something highly immersive, the display will probably lean towards opaqueness, but if you're acting mainly in the real world, the display will likely only show an transparent overlay with relevant information. The graphical representation of the projected entity should coincide with the purpose of it - if you travel in the digital world in order to attend a digital conference, you would be represented as an well dressed avatar of yourself, while a projected entity with the sole purpose of observing the digital world would be represented by a less complex symbol. You should always be able to with a glance deduct whether the person is present physically or digitally, or both. In the digital world, any surface could be manipulated to become a media outlet. For example, if you're doing a presentation or showing a video reel or your portfolio, you could designate an unoccupied area of the digital world to display it. In the same way, you would be able to shape the digital space of your house or apartment into a personal website of sorts and allow limited access to a public audience.
To view the real world from your digital presence, you would be able to stream data from physical public media installations. You could also request to connect to the physical interface of another user, allowing you to effectively "jump" between physical presences, experiencing the same spatiality as they are. Imagine being able to watch a football game, seamlessly switching point of view from a birds eye perspective of the field into a first-person point of view of any player. Then imagine doing the same thing, but to a cliff diver or a fighter pilot, adding a new meaning to the phrase "living vicariously through someone else".
This concept ties in to the idea of embodiment (Waterworth, 2012). There is altered embodiment in the sense that you have the cognition of your own physical body, but also a changed action potential - you can perceive what is around you, but you can also use the interactions available to your digital presence in order to navigate both the physical world and the digital information space. There is expanded embodiment in the sense that you are inside your body, but have a cognitive reach that far extends it - you can, for example, video conference with someone on the other side of the world. And finally, there is distributed embodiment in the sense that you can request to join in on the sensory inputs of another agent, to stream its visual and auditory perception to your own, in effect travelling into another body while still retaining your own.

Interaction and technology

My idea of the technology would initially consist of digital glasses interconnected to a network of nodes in your body or in your clothing that would translate your movements into the digital world. Software inside the glasses would be wirelessly connected to a network of servers that would project the digital world to the corresponding GPS coordinates (the accuracy of the GPS system would probably need to be improved) in order to track the physical position of the user and sync it with the digital world overlay. Applications could be managed on the user level, Further along in the future, cyborg-enabling surgery could be a way to permanently integrate the technology into the body of the user. For example, the glasses could be replaced with computer chips that project the image directly onto the retina and the sound could probably be managed in a similar fashion.

The main mode of interaction with the system will be through the user avatar, always defaulting to coincide with the physical location of the user. Imagine adding a “digital layer” on top of yourself to be able to interact with the augmented parts of the world. I am unsure how one would solve this on a technical level, but I figure methods like embedded RFID tags to track the movements of human limbs and fingers in real-time and project them in the digital world could be viable solutions. Most of the contemporary solutions to track finger movements are vision-based, meaning that a camera is tracking the location of the hand and translates the movement into digital markers in real-time. (Zhou, 2008) This could also be a solution, but I believe it might be limited in a number of ways that physical “anchors” aren’t. For example, it requires a line of sight and a field of vision, making it hard to, for example, touch type on a digital keyboard or operate on interface elements in the peripheral vision. For the same reasons, a head mounted camera can’t really be used to track the movements and positions of anything you’re not looking at, such as the rest of your body. A combination could be useful, however, allowing the camera (or maybe an ocular implant) to track what you are looking at and bring things into focus in the digital world in the same way as we bring things into focus in the real world. I believe haptic feedback will be big part of making the interaction feel natural. To accomplish this in a system that has no visible physical interface will prove to be rather complicated. A possible solution would be to add force feedback to the embedded technology, creating a physical sensation whenever the interface surface registers contact with objects in the digital world.
A complete prototype design of the graphical interface may be outside the scope of this essay, but the general idea is that you would use your augmented fingers to interact with personal digital touch screens, much in the same way as one would use a tablet today. Keiichi Matsudas Augmented City 3D (2010) is a good starting point, even though I disagree with the overwhelming number of digital objects surrounding the user in his vision. There could also be digital objects scattered in the world which you could manipulate manually and use to facilitate real world interactions, such as digital queue numbers and digital bus tickets.

Issues and questions

Anyone who has used GPS technology knows that it is not accurate in every situation, especially not considering very small distances. If the digital overlay of the physical world would be jittery and lack precision, the mediated presence of the situation would surely be disrupted. A solution could involve triangulating the exact location of the user in the system by using stable physical nodes or speckled computing (Benyon, 2010, p.491) , but that would add another dimension of management to the framework of the system.

To simulate a digital world as large as the earth promises to be a herculean task, despite the fact that only populated areas will have a significant amount of digital content. Since it is unlikely that enough processing power will fit into the user artifact (the glasses) to manage this simulation, we can use cloud technology to stream everything from remote servers. (Benyon, 2010, p.436-7) We'd also need to make sure that the power supply of the glasses lasts a good while due to the critical functionalities of the system.

As mentioned in the concept, I have some worries regarding the ergonomy of the interaction - how capable is the human body of interacting physically with a non-physical surface, and what are the long-term health effects of this kind of interaction?

The level of immersion and the issue of being able to separate reality from the mediated experience. On one hand you have the risk of getting used to the out of body freedom and inadvertently throwing your physical body off a cliff expecting to fly, and on the other hand you have the low presence of a system constantly reminding you whether you're currently controlling your physical body or your digital avatar. I don't think it would really be a statistically significant problem to make a system "too immersive", but we need to consider all the implications it can have for the safety of use.

What are our motivations to make aesthetic improvements to our surroundings in the real world if we can hide it underneath the digital world? Is it ethical to design something that could end up "usurping reality"? Could the physical world end up being nothing but a framework for the digital world?

Privacy and security issues will need to be very seriously considered in a system as extensive as this one. If the security of the software was compromised, a perpetrator could potentially even gain access to your line of sight, and that's pretty scary. There would also need to be an extreme level of public trust for the service provider since any misuse could be devastating for the privacy of the user. I wouldn't recommend this system in any other political context than a progressive and healthy democracy.

What it will mean for HCI

Over time, if we follow the current trend, the distinction between a human and a computer will grow ever weaker. Looking back to the early days of computer interaction, we mainly used computers at universities and businesses to automate mathematical calculations that would be too time-consuming for a human to manually solve. Thirty years ago, the personal computer started making it's entrance into everyday households. The internet was commercialized around twenty years ago, and ten years ago a majority of western homes had the ability to connect to it. (Child Trends, 2012) Today, the smartphone and the increasingly powerful wireless networking capabilities are transforming the way we use computers, allowing every individual a personal presence on the internet and it's social medias. In other words, the technology is becoming ever less obtrusive, but our digital sphere of influence is growing. With the contemporary computer hardware existing in our pockets and in our clothes, it can't really get any closer to us without entering our bodies. So we become cyborgs, or augmented human beings. As technology no longer will be distinguishable from our physical bodies, what viewpoint will we apply from a human-computer interaction stance? Is it still HCI if we're just interacting with ourselves? When we have perfected the conversion of binary into the neural signals interpreted and processed by our brains, will there even be a need for the field as it exists today? My guess is that the field would start focusing on the interaction between networked humans, maybe protocols of shared cognition or digital symbiosis, in order to predict and understand the ramifications of a

technological singularity. Thankfully, this paradigm shift seems to be a way down the road yet.

References

Iso, M. (2007). *Dennou Coil, Wikipedia*.
Available: http://en.wikipedia.org/wiki/Denn%C5%8D_Coil [2012-11-05]

Waterworth, J. A. (2012). Human-computer Confluence. [Powerpoint slides]
Available: http://www8.informatik.umu.se/~jwworth/Human-Computer-Confluence.ppt.pdf [2012-11-05]

Zhou, F. (2008). Trends in Augmented Reality Tracking, Interaction and Display: A Review of Ten Years of ISMAR. *7th IEEE/ACM International Symposium on Mixed and Augmented Reality*, 193-202.

Benyon, D. (2010). *Designing Interactive Systems*. Harlow, Essex: Pearson Education Limited

Matsuuda, K. (2010). *Augmented City 3D, Vimeo*.
Available: https://vimeo.com/14294054 [2012-11-05]

Child Trends (2012). Home Computer Access and Internet Use.
Available: http://www.childtrendsdatabank.org/alphalist?q=node/105 [2012-11-05]