ABSTRACT

Title of Thesis: WEB AESTHETICS AND THE EROSION OF THE REAL

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This paper argues that the visual language of the web as it exists today is a collection of simulations of the physical world that have, over time, replaced their referents; moreover, the current visual landscape of the web reflects its pervasiveness in every aspect of life. The early history of design for the web was shaped by visual metaphors in early GUIs, which used references to familiar physical objects to guide users. In its early days, web design was limited to creating readable pages with some visually interesting elements. As web technology became more robust, web design was able to develop its own design conventions, aesthetic trends, and user expectations, and designers faced fewer limitations in designing for the web. Today, the web plays a critical role in everyday life; contemporary web aesthetics are self-referential and no longer reliant on references to the physical world that the web has eclipsed.

WEB AESTHETICS AND THE EROSION OF THE REAL

by

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The Personal Computer and the GUI

The early history of design for the web was shaped by the history of graphical user interface design in the context of the personal computer. With the evolution of the personal computer has, naturally, come the evolution of the graphical user interface. The research informing the development of the first graphical user interfaces for personal computers also heavily informed design for the web at its outset. The evolution of the personal computer over time has deeply influenced the ever-evolving roles that personal computers have played in human lives. This section explores the history of the personal computer in the home and how the graphical user interface helped personal computers evolve from hobby to household appliance.

Computers and their accessories came into the world as sets of commodities that became introduced into the home and functioned similarly to other commodities of the time. As personal computers moved from research & development laboratories to the American home, they were not just "the computer", but a collection of accessories. Computers themselves were objects, and they needed a lot of objects to function. The more accessories a user purchased, the more functionalities became available. The first personal computers were introduced in 1975, and came as kits to be assembled. In 1977, Apple produced the Apple II, a color computer with floppy drive support and general use expansion slots (their first personal computer venture, the Apple I, was also a kit computer). Expansion slots could extend computer memory, expand display options, or allow the user to

connect accessories (Apple II Documentation Project). Computers were time-consuming and expensive hobbies that required learned expertise.

In 1978, electronic spreadsheet software established the computer as a business tool with potential (word processing software had existed since 1976), and a year later the first database software came onto the scene. In 1980, Commodore introduced the VIC-20, comfortably priced at $299.95 (adjusted for inflation, about $950 in 2017). The VIC-20 was the first personal computer to sell more than a million units, and after its introduction, personal computers flooded the market. In 1981, the IBM PC was released; it was a refined version of the customizable, all-in-one Apple II (Computer History Museum).

Once personal computers were being commercially produced for an affordable price, they very quickly found their way into homes, workplaces, and schools. The tech industry estimated that there were about ten million personal computers in use by 1983, and the 1984 census was the first to ask respondents about computer access inside and outside of the home. Per 1984 census numbers, 8.2% of households had a computer, and 9.1% of adults eighteen and over had access to a computer somewhere in their everyday life, whether at home, school, or work (U.S. Census Bureau, 1984).

Graphical user interfaces were an early factor in changing the way that computers were looked at, talked about, and thought about. While graphical user interfaces were not initially integral to the creation of personal computers, their absence was a major barrier that relegated early personal computers to the status of expensive hobbies. A terminal-based interface was not, for the vast majority, easy or

intuitive to use, and reinforced the idea of the personal computer as a simple machine. Only when personal computers were able to successfully incorporate graphical user interfaces into their programs and operating systems were computers able to assert themselves as something more than machines.

The visual metaphors in early graphical user interfaces relied heavily on references to existing physical objects, generally as they would be used within a space that provided context to those objects. These references were used in order to assist the user in more readily understanding how to perform tasks within an interface using context clues. The aesthetics and visual metaphors of early web design stemmed naturally from those used in graphical user interfaces. The metaphors used in web design mirrored and expanded upon the metaphors used in graphical user interfaces--in effect, references to the references. Once web technology evolved sufficiently to allow greater freedom of design, web design was able to develop its own design conventions, aesthetic trends, and sets of user expectations.

As computers evolved, the user's interaction style shifted from command line operating systems to graphical user interfaces that operated on visual metaphors. Early visual metaphors in user interfaces referenced other aspects of the physical world, specifically in the context of the desktop. When computers were created, the most marketable and monetizable purpose of the computer at the time was office work, so a desktop metaphor was the next logical step. Amiga at one point explored a workshop metaphor, but it ultimately was unsuccessful for a number of reasons, including the fact that work carried out in a workshop did not allow

sufficient parallels for the types of tasks that computers were marketed with and used for. The desktop metaphor encouraged the understanding of the computer as not just a commodity, but as a container that held the ability to perform functions. The computer wasn't just a multifunctional tool. It contained both the material of a user's work and the tools for manipulating that material--a digital office, contained within a monitor.

Computers became centers of activity rather than just an interesting hobby. At the same time as internet use became more accessible and widespread, the amount and physical bulk of accessories required for quick and easy use of a computer decreased. Storage disks were smaller, software programs began to be stored on CD-ROMs, and overall, computers had more initial out-of-the-box functionality. The computer moved away from being an assemblage of accessories and towards its future as a cohesive machine that acted as a united whole. Instead of many commodities, it was one commodity.

These factors, along with the advent of the desktop metaphor, contributed to the transition to a different understanding of the computer. With the installation of a web browser, the digital office contained a door to the world around it; that world could only be accessed by the brand-new door in the office. The computer became more than a commodity; it became a gateway[1] to cyberspace: a wide-open frontier with an infinite amount of space. The digital office was still there, but its uses

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[1] In fact, Gateway-brand computers began to rise to prominence around 1991, as the computer edged more towards existing as a unified whole.

comprised a negligible portion of the list of tasks one might perform on a computer.

Computers were once perceived as a machine like any other, but are now perceived as abstract objects whose primary function is as a portal to other spaces. These spaces are not physical; they may represent physical spaces or institutions, but they perform the vast majority of functions that were once performed in a physical space or by an institution. These immaterial spaces are now the fabric of daily reality. These spaces are also spaces in which interpersonal communication is mediated by computers. This understanding of the changing role of the personal computer, especially as it relates to physical spaces, is critical to understanding the factors driving the evolution of aesthetics in web design.

Understanding of computers was starting to shift from room-sized mainframes to accessible objects that could be found in the home. In 1982, TIME Magazine, instead of choosing a Man of the Year, chose a Machine of the Year: the personal computer. As a justification of this choice, TIME asserted that "computers were once regarded as distant ominous abstractions, like Big Brother. In 1982 they truly became personalized, brought down to scale, so that people could hold, prod, and play with them." Also in this issue, Otto Friedrich hopefully acknowledged the powerful present and future impact that computers had begun to have on day-to-day life:

"...the computer has been reduced so dramatically in both bulk and price that it is accessible to millions. In 1982 a cascade of computers beeped and blipped their way into the American office, the American school, the American home. The 'information revolution' that futurists have long predicted has arrived, bringing with it the promise of dramatic changes in the way people live and work, perhaps even in the way they think. America will never be the same."

However, computers had not yet achieved their social position as Time described

it. As Jodi Dean points out in *Publicity's Secret,*

 "One of the odd things about the *Time* feature was that the cover didn't show a
real computer or even real people using a fake computer...The computer, the
people, and the people's relation to the computer were imaginary. How could it be
anything but? In 1983, few people had any idea what to do with a computer."

(Dean, 2002)

It was true that not a lot of people knew what to do with a computer. Their

potential value was widely acknowledged, but computer interfaces rendered them

inaccessible to everyone but the dedicated hobbyist. As personal computer

workstations moved in, usability was an issue. Computers still looked and

functioned like terminals, with a cursor manipulated by a keyboard. Users

interacted with the computer by typing commands. Microcomputers ran CP/M[2]

or, after 1981's IBM PC, MS-DOS, which were both text-based operating systems

(Computer History Museum).

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[2] An acronym that stood for Control Program/Monitor.

Apple II's command-line interface

Advertisements in computing magazines from the early 1980s reflected this lack of user friendliness. These magazines were meant for computer hobbyists, and yet many of the advertisements indicate that advertisers saw both that computing was neither simple nor intuitive and also how that held many potential users back. Advertisements for software or operating systems were often focused on "ease of use" or making the system "friendly". Learning tools offered in the magazine ranged from word processors with built-in teaching tools to computer manuals on tape. One advertisement for CP+, an add-on software for operating systems that translated terminal language into more understandable terms, asked the reader, "Which would you rather speak, your computer's language or your own?" and advertised itself as "software that speaks your language" (Infoworld, 1982).

Infoworld Advertisement, 1982

The Desktop Metaphor

The idea of an operating system that was not based on a command line was not
new--it had existed long before the commercial personal computer. Douglas
Englebart demonstrated a system in 1968 at the ACM/IEEE joint conference that
included concepts such as windows, direct manipulation, hypertext, and
collaborative realtime editing, in a lecture known today as "The Mother of All
Demos". Englebart aimed to shift both the perception and reality of computing
technology from a machine that processed numbers to something that could
augment human capabilities for retrieving information and communication--from

quantitative to qualitative. The system was sophisticated enough to stun attendees of the conference. At the time, it was called the oN-Line System (now more commonly known as NLS); it was created and refined by the team at his Augmentation Research Center (ARC). Most of these researchers would depart ARC in the 1970s, and many ended up at Xerox's Palo Alto Research Center (Tweney, 2010).

The desktop metaphor was first put forth in 1970 by Alan Kay at Xerox's Palo Alto Research center and was developed and refined by PARC researchers in various iterations of operating systems that were intended to be as easy for the typical office worker to use as their own pencils and paper (Computer History Museum). Creating an operating system that wasn't terminal-based required, first, enabling computers to display bitmap images, and subsequently the creation of software that supported graphic display. The first full-fledged operating system based on a graphical user interface was in 1973, long before the rise of the personal computer. The Xerox Alto was never commercially available, but its influence spurred the creation of the first mass-marketed computer with a graphical user interface, Apple's Lisa. The Alto used a mouse, allowing users to directly manipulate the elements of the interface. It was one of the first interface to put to use a number of the concepts of Englebart's 1968 demo, including the concept of windows. Its screen was portrait-oriented, and it had word processing systems and a paint program, as well as a network-based multiplayer video game known as Alto Trek. It did not use the desktop metaphor (Toastytech).
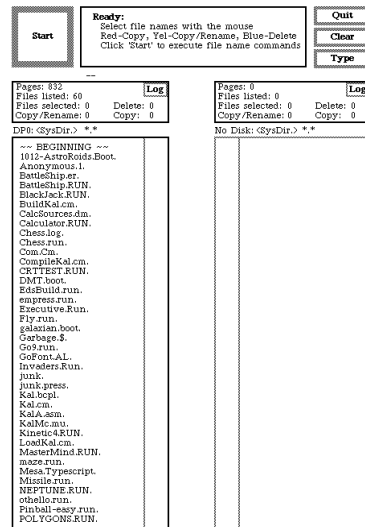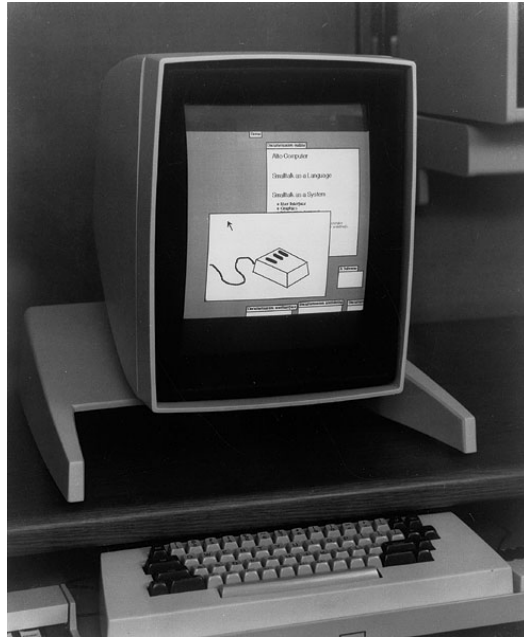
Xerox Alto Computer, right, and file manager interface, left

The first commercially available user interface that did use the desktop metaphor

was not an operating system, but a software program--a 1984 cartridge for the

Commodore 64 known as Magic Desk I. Magic Desk I was intended to make the

Commodore 64 more user-friendly by using familiar objects to relate to computer

functions (Toastytech, Magic Desk I for Commodore 64). The user used a

joystick to navigate to options and pushed the joystick button to select them. At

the time, computer mice existed, but were rarely spotted outside research labs.

They were not compatible with the Commodore and were generally too expensive

for widespread adoption. The joystick was a more cost-effective method of direct

manipulation (Frohlich, 1993).

The desk has drawers, a typewriter, a calculator, a clock, a rolodex, and a

wastebasket. Only some of of these images are linked to a Magic Desk function.

Files could be created in the typewriter, which had animations and sound effects

that imitated a physical typewriter, and could subsequently be archived into the

desk drawers or disposed of. The clock could be set, but none of the other

elements atop the desk had a functionality. These may have been intended for

Magic Desk II, but it never came to be (Toastytech, Magic Desk I for Commodore

64).

Magic Desk home screen (Toastytech)

Despite the fact that the concept of a graphical user interface as an operating

system had been established, it was not a commercial reality until 1983, when

Apple released Lisa. Lisa's early graphical user interfaces used terminology and

visuals that related the elements of the interface to objects or functions that a user

would have performed in their life before computers. The Lisa's operating

system, or Office System, takes its familiar visuals and terminology from an

office of the 1980s (Wichary, 1980). Upon booting the Office System, the

"desktop" is displayed. The Office System is laid out much like Mac operating

systems of 2017 -- a fixed menu bar sitting over an open area (the "desktop"),

with large illustrated icons representing different functions and destinations. The

menu bar has broad categories, the contents of which are styled as drop-down

menus (likened to a roller blind in Apple's documentation of Lisa's creation).

These categories change between versions of the Lisa operating system, but

usually include File/Print (as one function) and Edit while on the home

screen.There are no icons in the drop-down menus; these are relegated to the desktop.
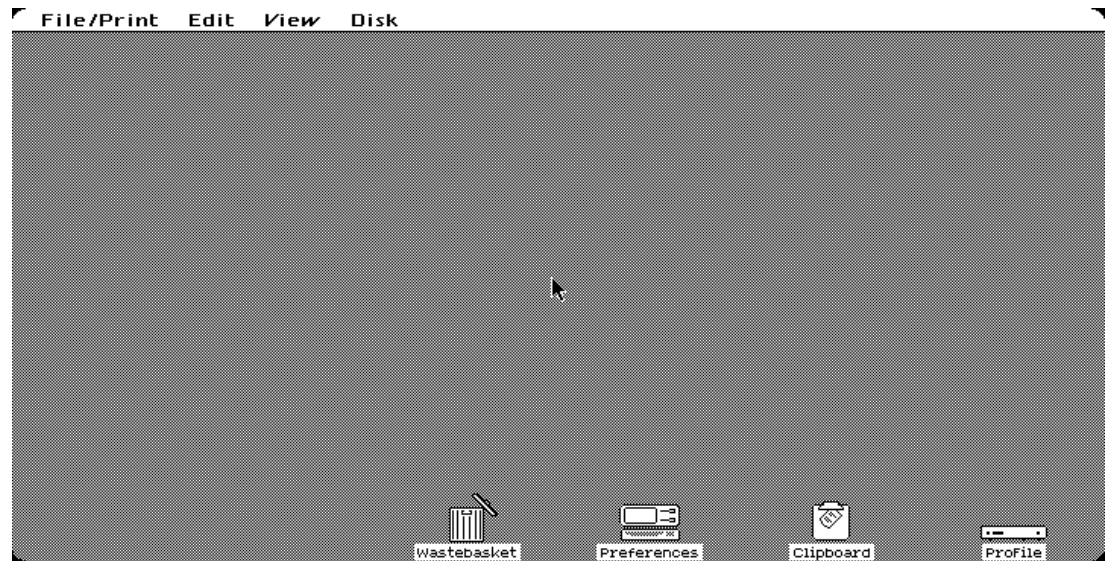
Apple Lisa's desktop (Toastytech)

The desktop icons include the first-ever trashcan icon, labeled 'Wastebasket', with a lid that's invitingly tilted open, the 'Preferences' icon, depicting a stylized version of the Lisa herself, the 'Clipboard' icon, with a cockeyed scrap of paper on a clipboard, and a 'ProFile' icon, an image of the external ProFile hard disk. These icons vary between symbolic and literal. The Wastebasket and Clipboard icons use physical objects to help the user link a digital function to a familiar object. "Just as the office worker can retrieve something thrown away in the wastebasket, the Lisa user can retrieve objects thrown in the wastebasket"(Birss, 1984). The Preferences and ProFile icons are much less specific in their intentions. Both icons depict the exterior of the machine in front of the user, indicating to the user that the machine is an object that can be manipulated through this interface. Contrary to prior methods of human-computer interaction,

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which consisted of physical manipulation of the machine itself, the user is not

encouraged to understand the workings of this object. The image is faraway,

vague, stylized. The user is interacting with the simulacrum of a computer at the

same time as they interact with the material reality of the computer.
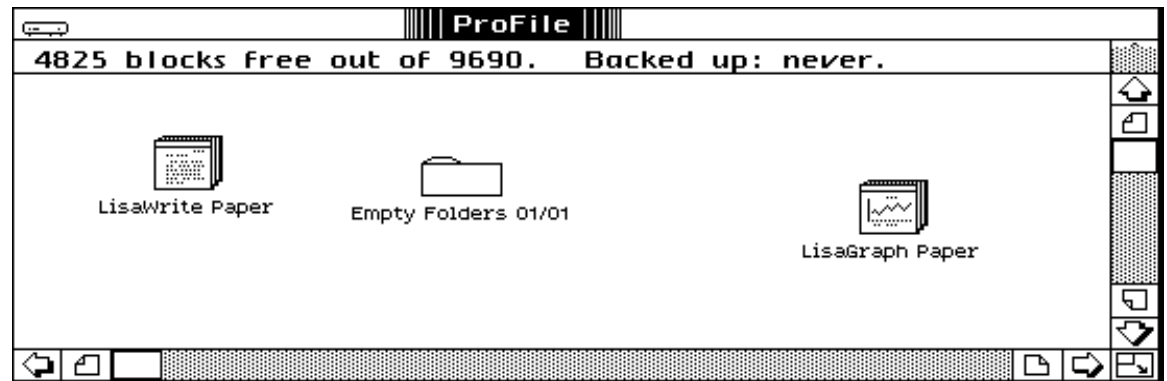
Apple Lisa also included three other types of large-scale icons--stationery pads,

documents, and folders. The document icons show the user at a glance what kind

of document it represents. The word 'Stationery' longer regularly found in a

digital word processing context, but the general concept has persisted. In Lisa,

stationery helped a user create new documents and to configure document

templates. Edward Birss, writing about the Lisa desktop model for Apple in 1984,

likened the stationery function to "different types of paper stock" in an office,

where "one might be used for letters going outside the office, and another for

interoffice memoranda". In Lisa's digital office, a user would set up a stationery

pad for whatever types of documents they may need, and then take a new page

from the appropriate stationery pad for creating a new document. To this day, the

icon representing a new document on any word processing system, a page with

the top left corner folded, visually represents Birss' description of "[tearing] off a new piece of letter stock from the appropriate stationery pad" (Birss, 1984).

Cover of 1982 Infoworld depicting three-button mice

Users having the ability to to directly manipulate interface elements was a novelty when the Lisa was created. At the time, command language, not direct manipulation, was the norm for computing. Cursors existed, but did not have the range of motion afforded by a mouse, and the creation of a commercial graphical user interface afforded the perfect opportunity to utilize the possibilities provided by a computer mouse. Computer mice were not entirely new technology in 1983; they had existed since 1961, but they were prohibitively expensive and confined to research & development labs. An issue of "microcomputer user" newsweekly InfoWorld from May 1982 depicts computer mice on the cover and gossips inside about the possibility of Apple's still-unannounced Lisa project having a mouse. Three-button mice were still the norm then, but Apple's Lisa team reduced the number of mouse buttons to two, and then later to one as they discovered alternative ways to implement their desired features (Infoworld, 1982).

Birss' description of the Lisa graphical user interface clearly states the philosophy behind the Lisa GUI. It's meant to link concepts of the physical world to concepts of the digital world, which helps the user to accurately predict how the interface

will behave when they interact with it. Lisa was developed with a focus on ease of use and minimal learning. It abandoned the concept of modes in favor of enabling the user to complete any task at any time. This concept had previously been executed in the form of the Xerox Alto (Birss, 1984).

Lisa was the first commercially available computer with a Graphical User Interface, but its sale were hampered by the substantial price tag ($10,000 in 1983, which amounts to about 25,000 in 2017). The price put it far out of the personal computer range, but the product didn't have sufficient support or resources for business use. At the time, the IBM PC had the business market cornered due to its lower price and its compatibility with existing software. Lisa's commercial failure set the stage for 1984's comparatively affordable Apple Macintosh. The Macintosh also had a GUI, but its interface was less document-based than the Lisa. Many elements of Lisa's interface would resurface in later interfaces, and Lisa bears a strong resemblance to desktops of the present day.

Lisa may not have been successful, but its legacy lived on. The concept of using familiar elements to guide users through an interface persisted, and the framework of Lisa's Office System 1.0 shares a lot in common with a contemporary desktop computer--including the concept of a desktop itself. As web aesthetics have shifted rapidly, operating systems have remained more or less the same on a visual level.

The early visual metaphors that pervaded graphical user interfaces and persist to this day helped users to interpret the computer as a space. This space was not a space in the sense of what had previously been understood as a space; it was

something entirely different--a new frontier. The space that these graphical user interfaces established was a limited one. There was a finite amount of tasks that could be performed within a personal computer. More tasks could be completed with the purchase of various software programs, which expanded the limited space. However, with the advent of the web and the increasing accessibility of browser technologies, the space that a user occupied within a desktop computer suddenly had another door. That door led to an infinite space that was connected to the world in a way that personal computers had never been previously connected.

Personal computers were a hobby until command-line interfaces were eclipsed by graphical user interfaces. These graphical user interfaces opened the door for less experienced users by using familiar visuals to orient them. The desktop metaphor was established early in the development of graphical user interfaces, but took some time to become commercially available and standard in operating systems. These factors, along with the changing physical nature of computers from an assemblage of accessories to a cohesive system, established personal computers as a common household object.

The Web

In this section, I discuss the thought behind the creation of the internet and how the browser wars lead to the quick spread of web browser technology. The following segments outline the evolution of web design over time, and the ways in which technological factors influenced web aesthetics as web technology

evolved and technology became more robust, including the early days of web design, the advent of Flash, and its effect on web design as a whole. In 1980, Tim Berners-Lee created Enquire, a hypertext program with pages (called "cards") and hyperlinks within those cards. This was an extension of earlier hypertext work, which had originated with Vannevar Bush's 1945 imagining of a futuristic device that created "trails" of pages and had continued through Ted Nelson's Project Xanadu and Douglas Englebart's NLS system in the 1960's. Enquire was a large portion of the conceptual framework behind Tim Berners-Lee's first prototype of the World-Wide Web in December 1990 (Computer History Museum). His prototype included a browser and html editor all in one. By 1994, Silicon Valley had begun investing in the commercial web, funding the development of the Java coding language and the Netscape browser (initially the Mosaic browser). Al Gore encouraged the funding of the World Wide Web Consortium, which continued to develop the framework of the web. At the same time, a variety of companies began to create and promote browser technology. Development of browser technology was quick and new versions of browsers were constantly being released in a battle for market share that is now known as the first browser war. Mosaic's advanced features and, later, its built-in email client, allowed it to dominate the browser market for a short time (Peter, 2004). Windows ultimately managed to corner the market by giving away their browser software, Internet Explorer, free with copies of the Windows 95 operating system. The 1989 U.S. census reported that 15% of households had a computer, and the 1993 census reported that 22.8% of households had a computer (U.S. Census Bureau, 1989,

1993). Commercial, paid online services, which had existed as early as 1979, enabled users to link into private networks with news, weather, information, and communication services. As the open web spread, these online services turned into web portals, most notably in 1995 when Bill Gates elected to transition MSN from an online service to a web portal.

During this time, it was common to see websites indicate their preferred browser; often, websites were designed with just one browser in mind and would be minimally functional on others. Complete cross-browser compatibility was nearly impossible to achieve at this time. The Mosaic browser was released in January 1993, and its ability to display inline images, sound, and video, its intuitive interface, and its compatibility with a variety of common operating systems spurred an exponential level of growth in web browsing. Mosaic's release coincided with the release of HTML 1; the language included support for hyperlinks, basic text formatting, and display of html code on a page. Basic text formatting including ordered and unordered lists, headers one through six, and page breaks (Shannon). In June of 1993, five months after the release of Mosaic, there were 130 websites. One year later, there were 2,378. Another year later, in 1995, Mosaic had 53% market share, HTML 2 had been released, and users had 23,500 websites to explore (Gray, 1996).

Designing the Web

In the late 1980s, there was no ability to design a digital page. Web pages were text only, and browsers didn't have image display capability. Web pages were single-column, left-aligned blocks of unstyled text. Links, the basis of the concept

of the web, were denoted by a different color of text. This style can be seen in the first site on the web created by Tim Berners Lee in 1991. Browsers eventually gained the capability to display images, but not inline with text--only as hyperlinked documents that would open in a separate window. HTML 2, released in the mid-1990s, added a significant amount of functionality, including image tags, more robust text formatting, tables, and forms, and allowed for some level of design on the web. Pages were no longer strictly single-column, which allowed for better content organization and more consistent and advanced navigation (Rinehart). Any internal navigation was done with collections of links, often grouped by a menu tag, on the top or bottom of the website (Web Design Museum). Since CSS didn't exist yet, any structured delivery of information had to be done with tables--the closest designers could get to creating a grid. Particularly inventive designers would design a webpage as one image in an image processing program, and then slice it up into fragments, inserting those fragments into the backgrounds of tables (Siegel, 1996). In 1994, GeoCities (originally known as Beverly Hills Internet) was founded as a hosting service with a page builder that allowed anyone to build their own homepage. More possibilities opened up in 1995 when Javascript shipped with Netscape Navigator 2.0 and became generally available. It expanded the technical abilities of the web by giving web designers and programmers the ability to dynamically modify data, create plug-ins, and show pop-up alerts (NYU Dead Media Archive, 2010).

Exploration, Experimentation, and Understanding

In 1996, web designers were freed from the constraints of HTML 1 by the release

of Flash. Webpages that had once been a series of complex nested tables were no

longer limited; any layout could be created, using any font, and Flash supported

animation and interaction. Users could build entire websites with Flash and nest

them inside the browser with a single file. But for all its freedoms and

innovations, Flash had a number of drawbacks. It required a plugin, memory

resources, and loading time, at a moment when dial-up was the main method of

connecting to the internet. It also wasn't indexable by search engines. With the

advent of Flash came the advent of splash or introductory pages. One of the early

purposes of splash pages was to allow the site to launch itself (with Javascript) in

a resized popup window without any browser toolbars, for a pristine user

experience. Splash pages also often doubled as loading pages for larger Flash files

(Donnelly, 2002).

By 1997, computer and web use were rising at at exponential rate. 36.6% of

households had a computer, up 13.8% from 1993, and about half (49.1%) of

households with a computer had acquired it in 1996 or 1997. 22.2% of Americans

were internet users. The internet's primary uses for adults 18 and over were email

or IM, information on government or health services, and news, weather, or sports

information. Only 2.1% of adults reported using the internet for shopping in 1997

(U.S. Census Bureau, 1997). The web was not yet an obligation or a necessity, but

an activity and a resource. The web was as anonymous as the user wanted to be,

and websites had limited connection to each other (as opposed to the onmipresent

and interconnected web systems today). Online identity wasn't tied to personal identity.

This era of the internet was a period of exploration and experimentation. Having internet was not the assumed default, and census data indicated that it wasn't yet regularly used for job-related tasks. Users and creators of websites were still trying to understand what possibilities a website held. Users and creators were often also the same people--as page-building and web-hosting tools became more accessible and robust, casual users of the web began to create their own spaces. Creators and users were all trying to understand what worked on the web and what didn't.

Because of the web's inessential status in this moment, design best practices and usability considerations were less important to users than a novel and engaging web experience. Hartmann, Sutcliffe, & De Angeli, in their studies of user interface preferences, found in three consecutive studies that users consistently favor a visually pleasing interface that engages their curiosity over an interface that clearly communicates information, even if they have found the engaging interface to be difficult to learn, use, and navigate(Hartmann, Sutcliffe, & De Angeli, 2008; Hartmann, Sutcliffe, & De Angeli, 2007; De Angeli, Sutcliffe, & Hartmann, 2006). In the nineties, nowhere were these priorities more apparent than in the way competing browsers tried to appeal to their audience. The mid-nineties found Microsoft and Netscape locked in a bitter war for browser market share. The browsers began to compete by creating their own proprietary HTML tags, racing far ahead of the development of HTML standards. Each company

created and publicized their own HTML tags, mostly for the purposes of novel design features or new layout options. Websites using one browser's tags were only supported by the originating browser, and would display incorrectly on the other browser. The most notable of these was Netscape's <blink> and Microsoft's <marquee>.

The tags were quickly adopted by web designers, and their use signified a cutting-edge website. At their peak, they were considered attractive and exciting web design tools, despite their limited utility and poor usability. Hartmann, Sutcliffe, and De Angeli's research established that users' overall visual impression of a system can determine user satisfaction with a system, even if users consider the usability experience poor and the content poor (Hartmann, Sutcliffe, & De Angeli, 2007). Marquee and blink tags eventually went completely out of style, as critics began to assert that nothing so inaccessible and irritating should be that ubiquitous. HTML standards committees convinced the two companies to quash the tags, and Microsoft eventually edged out Netscape's intense competition by including Internet Explorer free with every version of Windows '95 (Rinehart) .

Web Design in the Early 2000s

The increased use of Flash technology in web design set new aesthetic standards in web design. Previously, design for the web was limited by mechanical considerations. Almost every aspect of a website's design could only exist in the context of what HTML could accommodate, and no matter how creative the designer was, these limitations were clear. Flash changed all of that. The design

portion of Web design didn't have to be done with code anymore, but instead could use the Macromedia Flash drag-and-drop interface. A design mockup done on a computer in the right dimensions could be easily and faithfully converted into a fully functional website; not a millimeter of the layout would have to change to accomodate functionality constraints. Designers could seamlessly incorporate animation, use whatever font they pleased, and lay their site out however they desired, all in a single file. Code was still in play, of course--Flash files had to be embedded and formatted within an HTML container, and ActionScript (Macromedia's scripting language, similar to Javascript in its syntax) gave the Flash file its functionalities. But the fundamental shift in the understanding of the possibilities of web design had happened. Websites could be distinctive and individual pieces of work with absolutely no resemblance to each other. In the early days of web design, websites understood and referred to themselves as spaces, but were only able to act as, and look like, dynamic documents. Websites in the age of Flash were able to fully become those spaces and lost all resemblance to HTML documents. The age of Flash was not forever, but it marked a shift in conceptions of the possibilities of the web.

As the web grew, users became more accustomed to webpages, although not everyone regularly used the web or had a home computer. In 2000, 51% of households had a computer, and 42% had home internet access. Internet users reported using the internet largely for email and information such as news, weather, and sports (U.S. Census Burea, 2000). Around this time, advances in technology allowed web pages to become more elaborate. Websites were able to

experiment with layout and navigation, since users were more skilled and design possibilities had been expanded. Designs were able to become more creative, but they still heavily referenced the physical world. In the 00's, this manifested in several different ways.

The shift towards more tactile designs that began in the early 2000s stemmed from many factors. Computers and internet connections were able to load more data quickly, and scanning technology had substantially improved. In addition, cookies had become a valuable way for web designers and developers to decrease loading times for returning site visitors. HTML and CSS had more graphic capabilities, and the designs of Flash websites weren't constrained by what designers could accomplish with coding language. On a conceptual and artistic level, it was a response to the flat, neat, and tidy nature of web design. Visible textures, grunge, and organic shapes were design elements that were rarely seen in the early days of the web because they were difficult to create and slow to load (Heller, 2009). Finally, as web interfaces built their own visual languages, the ways in which they referenced the real evolved.

Due to increased technological ability, including faster loading speeds, better scanning technology, and cookies, websites were able to incorporate more photographic elements into their design. A style of design that was present in the early nineties and became increasingly common with the advent of Flash technologies was the use of either a digitally drawn or scanned object into which digital functions or content were placed as the layout for the website. This could be as minimal as a scanned paper background or as thorough as creating a

facsimile of a jukebox as a music-playing interface. Tactile textures or fonts were also in style for web designers at this time, and often paired with other scanned media to produce a handmade effect (Donnelly, 2002).

As graphic capabilities expanded and visual metaphors drifted further and further away from what they originally represented, skeuomorphism started to become present in web design. The forms this took ranged from replicating physical objects in interfaces to extend a metaphor even further to design elements like gradients and drop shadows, that reference a three-dimensional world.

Conceptual Foundations

As websites grew in number in the early 1990s, they evolved in purpose, and the ways in which websites were used steadily expanded. Although there were a vast variety of websites online, there were two conceptual approaches to web design: a dynamic document, or a location in cyberspace. These approaches reflected different intentions and served different needs, but most websites of the mid-nineties mixed the two concepts. Often, websites would have elements of both approaches, but would lean in one direction or the other. Some leaned heavily towards document, some towards location, and others struck a balance of approaches.

The more minimal websites tended towards being more document-like, while the more colorful and design-inclined websites tended to refer to themselves as a space. Document-like sites looked and acted like Tim Berners-Lee's concept of the web. Sites like these often offered a justification or purpose for their

existence, almost like a thesis statement. Many had what amounted to a table of contents on the landing page, with page titles and short descriptions of their contents (Web Design Museum).

These document-websites often provided the date and sometimes the time--just what a user would expect from a document come to life. The focus of sites like these was on the content, and they were often extremely text-heavy with a writing style that contemporary users would consider verbose.

The location approach was a popular one, especially with people or companies trying to establish a feeling of personal rapport with their visitors. They'd "welcome" the user to the site, sometimes with a message several paragraphs long, and tell them where to "start [their] visit", suggesting a journey through their website that hit all the major stops. The Budweiser website implored users to "stop by and chat" or "hang out", and the Toyota website advised users to "explore" and "come back often", referring to their site as a "place". Many websites advised the user to sign their guestbook. The Chevron website in 1997 had a standard navigation menu on their homepage, but it was alongside a map of "The World of Chevron", styled as a small slice of land with a road winding through it. The various pages of the Chevron website were associated with locations or symbols on the piece of land. The Playboy website took a more abstracted approach, displaying pages as though they were planets in a stylized solar system, with the Playboy logo as the sun.

The language that was used to refer to exploring websites and viewing pages was more or less the language of exploring the physical world, but with the acknowledgement that the exploration was of cyberspace. Cyberspace was most easily understood, and popularly depicted as, something almost like a physical place to to be explored. The visual of the grid line as a shorthand for cyberspace may have been established earlier, but the 1982 film Tron turned it into a visual convention. Tron is one of the earlier films to represent the concept of humans exploring cyberspace; the film's story is that of a computer programmer who

becomes trapped in a computer's mainframe by a evil supercomputer and is forced to use software in order to escape.
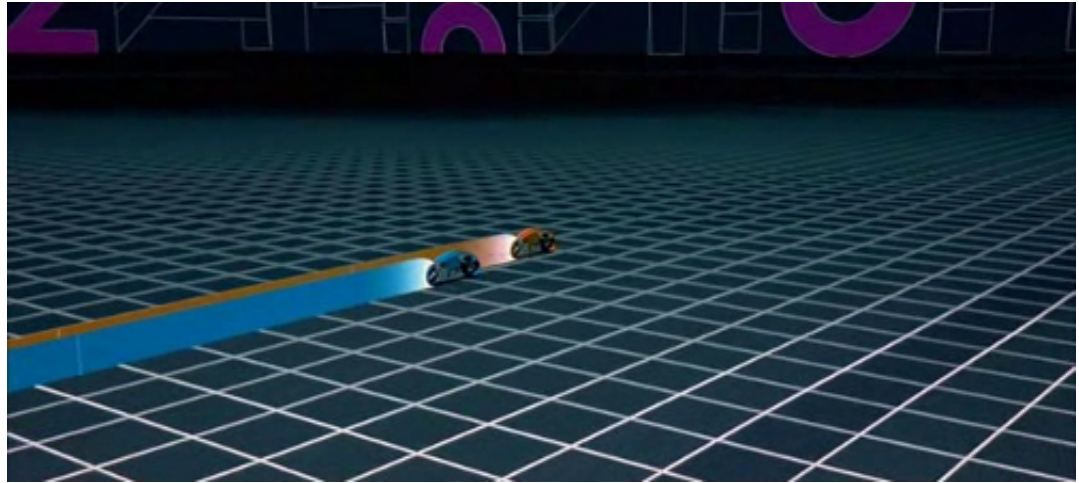
Tron's most famous scene, depicting a light cycle race in cyberspace (Tron, 1982)

Popular depictions of cyberspace showed a void with grid lines, or sometimes complex symbols resembling a stylized motherboard, stretching into distant space. Cyberspace was vast and inherently infinite, a place of machine-perfect straight lines. Media that depicted cyberspace in this way was often dramatic or fearful in tone, if not both. In the mid- to late-1990s, Geocities, a web hosting service that allowed anyone to build their own webpage, allowed users (known as "homesteaders") to select the "neighborhood" where their site should be built. The service started with six neighborhoods, but had expanded to twenty-nine within a year of its launch. When a user built their homepage, they were assigned a number in the context of their neighborhood, like a street address. The neighborhoods had broad themes, but content didn't need to be location-specific. Geocities was designed upon the concept of a web spaces as physical spaces and every design element reflected that.

In the same 1982 issue of TIME that named the personal computer the Machine of

the Year, Roger Rosenblatt's essay, "A New World Dawns" extolled the virtues

of the computer age, envisioning a new era of American pioneering and

innovation made simple by computers: "there's a New World coming again,

looming on the desktop." He talks lovingly of a bright future in which a nation,

struggling with fulfillment in a post-Industrial revolution world, uses computers

to automates the paperwork, eliminates the commute to work, and achieve total

social equality. In this new World, computers help us take back our time and

allow us to dream again.

> "What our forefathers (bless 'em) wanted was the land, not machines, the
> great, wide, beautiful land that was thought to go on forever. When the machines
> came clanging along, they were supposed to let folks enjoy the land more, the
> green grass and the blue water. Only they got out of hand, you see, until all the
> lovely forever greens and blues got squeezed in a corner full of national parks and
> the sky choked black with factories. That isn't what we intended, though.
> Machines were meant to open the territory, not close it down. What's all this got
> to do with computers? you ask. I'll tell you. They reopen the territory, that's what
> they do. Oh, not the land, of course. That's gone like the topsoil, with the wind.
> But the land was never our real territory anyway. It was the dream, my friends;
> the territory was always the New World ideal. We don't ever want to run out of
> that, do we? Goodbye land. Hello space. Can't you picture all those moons and
> stars, smiling and winking and waiting for a visit? Howdy, Mr. Jupiter. Inventions
> arise when they're needed. This here screen and keyboard might have come along
> any old decade, but it happened to pop up when it did, right now, at this point in
> time, like the politicians call it, because we were getting hungry to be ourselves
> again."

Rosenblatt directly links the concepts of early American exploration and

colonization of territory with the nation's newfound computing capabilities. He

paints a picture of a new socially equal world, unencumbered by rote tasks that

can easily be automated.

The Social Web

In the mid- to late-2000s, the way people used the web was starting to change. In

2003, 61.8% of American households had a computer and 54.7% of households

had internet access. Internet access was becoming inextricable from computer

usage--83% of households without the internet also didn't have a computer. Those

households who did have a computer but no internet access cited lack of need

(30.6%) or high cost (31.1%) as the two biggest reasons for lack of internet

access. 55% of adults used email or IM, and 40% of adults accessed information

on news, weather, or sports with the internet. Only 32% of adults used the internet

for shopping (U.S. Census Burea, 2003).The term "Web 2.0" was popularized in

2004, and was broadly understood to describe a shift in the nature of the web

away from personal websites toward the beginnings of the social web. In *New

Media*, Terry Flew characterizes this shift as a

"...move from personal websites to blogs and blog site aggregation, from
publishing to participation, from web content as the outcome of large up-front
investment to an ongoing and interactive process, and from content management
systems to links based on "tagging" website content using keywords"

(Flew, 2008)

Web 2.0 emphasized networks and facilitated conversation and connection.

Websites became more dynamic, both in design and in technology, and user bases

expanded past early adopters into the mainstream. Large companies, such as

Google, Ebay, and Yahoo, began to dominate the web, and websites began to

share data and connect with each other, encouraging the concept of single-identity

web users. Web design for the social web focused largely on minimal websites

using bright colors and unique touches. Designs often used cuteness as a way of

appearing professional but still attempting to connect with the user. This could

come in the form of icons, illustrations, or language--even 404 pages could be

cute (Quoc, 2006). By 2007, 61.7% of households had internet at home, and it

was largely broadband (50.8%). Only 10.7% of households used slower, dial-up

internet, and only 38.3% had no internet at home whatsoever. However, 71% of

households had at least someone who accesses the internet regularly from

somewhere, if not necessarily their home (U.S. Census Bureau, 2007).

Changing Spaces

Today, websites have established their own visual languages and sets of

expectations. Early symbolic icons referenced the physical world, but newer

symbols, created to better serve the evolving needs of the website, reference

elements of digital interfaces. Web design trends in the mid-2010s were heavily

influenced by the rapidly increasing percentage of users who primarily accessed

the web using mobile devices. In 2011, 48% of Americans fifteen years of age

and older were smartphone users, and 75% used either a smartphone or a

computer. By 2015, 75% of American households had a handheld computer or

smartphone--just short of the 78% of American households that had a laptop or

desktop computer. In fact, 65% of American households had both types of

computers in addition to a broadband internet connection in 2015 (U.S. Census

Bureau, 2015). These rapid changes in use habits and display devices forced

designers to rethink basic assumptions and conventions of web design. Websites

were no longer a niche hobby or a novelty, but a fact of life that users had to

contend with on a daily basis. Users, especially mobile users, could be assumed to be more experienced and skilled in using websites.

The evolving visual language of the web built upon that assumed experience and skill with design elements that referenced established standards. The hamburger menu icon is an example of this phenomenon. Although it was originally created in 1981, it did not appear on the web with any frequency until designers had to contend with mobile displays (Alday, 2014). The hamburger menu is a simple icon, consisting of three horizontal bars, that indicates to the user that a menu is available but hidden. Visually, it's meant to be an abstraction of a list of items, but it's used exclusively to denote a navigation menu. There are other menu icons that serve a similar function, such as the kebab (three circles stacked vertically atop each other) or the waffle (a three-by-three square grid). These menu icons exist within the context of other representational icons, but they are not representations of the real, and they have no original. Rather, they are abstractions of digital elements.

Mobile development also changed the expected behavior of a webpage. Websites began to abandon the traditional concept of multiple pages devoted to different subjects in favor of single-page layouts (known as "infinite scroll"). Mobile devices lend themselves to scrolling, and having to navigate to different pages for information can disincentivize a user from further interacting with a site. The potential for slow loading times or unexpected page behavior is present in clicking in a way that it isn't in scrolling. Designing a website to encourage

scrolling allows the designer to get a maximum of information in front of the user, and eases the burden of website navigation upon the user. A fixed header or fixed navigation also came into style as mobile users became more prominent. This allowed users to orient themselves while navigation and branding remained easily accessible and visible.

Design trends moved away from skeuomorphism and towards a flatter aesthetic, and in 2013, Apple discarded the skeuomorphist elements of their operating system, transitioning to a flatter design to keep up with current design trends. These small references to the physical world disappeared, but were replaced with other design elements that served similar purposes. Parallax scrolling came into vogue in parallel with infinite scrolling as designers sought to divide sets of information and maintain visual interest. This technique uses a foreground and background; design elements in the foreground scroll at the expected rate, while elements in the background either scroll at an unexpected rate or do not scroll at all. The technique creates depth and implies a multi-dimensional space where there isn't one. Gradients and drop shadows, in their web design prime, fulfilled similar functions to parallax scrolling. They all reference the multidimensional physical world in subtle ways and enforce the concept of websites as spaces.

Quantifying Aesthetics

In 2004, Talia Lavie and Noam Tractinsky set out to build upon what little research existed in order to understand how users perceive and assess web aesthetics. Historically, the field of Human-Computer Interaction has disregarded

aesthetic considerations. HCI researchers tend to focus on quantitative measures that relate to user and system efficiency, rather than an assessment of aesthetics. When aesthetics are assessed, they are often assessed on a one-dimensional basis, without taking into consideration the wide variety of ways in which something such as beauty can be expressed.

Lavie & Tractinsky's framework of user aesthetic assessment consists of two dimensions: "classical aesthetics" and "expressive aesthetics". The dimension of "classical aesthetics" is described as representing traditional notions of aesthetics. Users described websites with a more classical aesthetic as clear, clean, symmetrical, and well-organized. "Expressive aesthetics" refers to aesthetics that extend beyond the classical principles and showcase the designer's creativity and expressive power. Users described these designs as original, with fascinating design, and noted that special effects were often common in expressive designs. Lavie & Tractinsky found that classical aesthetic tends to be linked with usability. Furthermore, websites judged as being "clean" (characterized by users as simple and minimalistic) within the dimension of classical aesthetics are significantly correlated with actual (not just perceived) accessibility (Mbipom, 2009).

The criteria with which people evaluate website credibility does not differ to any great degree between users of different ages, education levels, genders, or any other demographic marker (Fogg, 2001; Kakol, Nielek, & Weirzbicki, 2017). Visual aspects of an interface need to match current styles in order to be perceived as credible and usable. Users see recent updates to be a mark of credibility in websites. Perceptions of web aesthetics and usability are highly correlated, as well

as perceptions of web aesthetics and users' favorable perceptions of an interface (Kurosu and Kashimura, 1995; Tractinsky, 1997; Tractinsky et al., 2000). Users tend to believe, even unconsciously, that good design is linked to quality content and usability (Moshagen & Thielsch, 2010). In a study in which participants were presented with two websites with identical content, one of which had received significantly more aesthetic treatment than the other, users consistently judged the credibility of the aesthetic website as higher. The users spent less time on the website with less aesthetic treatment, suggesting that if a site does not look aesthetically pleasing, users will not want to invest time in determining credibility, as it is less likely to be credible (Robins & Holmes, 2008). In addition, the more visually attractive a user finds an interface, the more persuasive they find it (Fogg, 2003).

Establishing and maintaining credibility in websites is more critical now than it has ever been. Websites, in their earliest form, disseminated information between a limited number of machines. As websites became more accessible to use and easier to create and customize, they were an amusing hobby. Web design was not of critical importance; the stakes on the web were low. Today, major institutions are functionally nothing but their own websites. There is no longer a meaningful distinction between an institution's online presence and the institution itself; the simulation has prevailed. Computing technology has restructured every significant aspect of everyday life.

Websites that would be defined as high in creative aesthetics by Lavie & Tractinsky, with a heavy emphasis on design and layout and low emphasis on text

content, also fall in line with the concept of websites-as-spaces. These sites go beyond the simple goal of transmitting information; they intend to create a space that represents the cause, company, or group. The space is designed to provide the desired image and users are guided through that space-- the virtual equivalent of a factory tour. The space is designed in a way that enables its transformation into what it was created to represent, furthering the intertwining and inextricability of something's internet presence from the thing itself--the simulation from the real. If those creating the representation strive to create a faithful and serious digital representation of something, that performs the functions and serves the needs that the represented object, service, or establishment serves, users will consider the representation with that same level of seriousness. This type of approach to websites has carried through and evolved over the years, and it's the same kind of thought that has evolved with the state of the internet today and its evolution into a replacement for physical places.

Skeuomorphism, Simulacrums, and Trusting the Simulation

In Jean Baudrillard's *Simulacra and Simulations*, he establishes the framework of signs, simulacra, and simulations. Baudrillard argues that in today's society, the material has been replaced with simulacra, which are copies that either no longer have an original or never had an original to begin with. These simulacra work together to form a simulation, which is a facsimile of a real system, process, or institution that imitates the operation of what it represents.

In the very first commercial graphical user interfaces, icons used familiar physical objects to help the user understand the approximate functions that the icon represented. Today, the icon itself is familiar to the user; the user infers the functions that the icon represents based on other functions that similar icons in similar contexts represented. Many interface icons still reference a physical object, but conditions of these references have changed. Some icons do not reference a physical object at all, and represent concepts that do not exist in the physical world. Both types of icons are simulacra on a microscopic level, operating within the grand scale of simulation. They depict things that either no longer have an original or had no original to begin with. In many cases, the original was eliminated as the simulation became increasingly functional.

The icons that did have an original tend to fall into one of two categories. Either they reference a physical object for a function that is related, but not a direct parallel to the original day-to-day function that that object performed, if it did perform a day-to-day function, or they are referencing a physical object for a use that is a direct parallel to its prior day-to-day function, but not one for which that physical object is now commonly used, because it has been replaced by the digital functionality for which it is a visual representation. The artifacts from the first category are familiar physical objects, but represent abstractions of their original functions. The bell icon is an example of an artifact in this first category. In websites and user interfaces, the bell icon is generally used to refer to notifications. Both the website Twitter and Apple's operating system, among other interfaces, use it in that manner. The concept of notifications on websites is
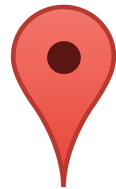
a relatively new one that came about as the web became increasingly social in nature. In the past, the bell has not been a symbol of interpersonal contact. The magnifying glass icon is another example of this first category. While its original function is to magnify something, its function as a digital symbol is multifaceted. It is used most commonly on the web to denote a search function, although it's also used for a zoom function (often with a plus or minus sign). The zoom function does closely align with the original function of the magnifying glass, but the magnifying glass is most commonly seen in search boxes everywhere, so much so that the image is synonymous with the concept of searching. When a user sees a magnifying glass icon in a web context, they can expect that it refers to a search function. Physical objects become images that represent concepts, but these images do not act as replacements for those objects; instead, they give those objects a new depth of meaning.

The artifacts in the second category have not yet completely disappeared, but, by and large, their capabilities have been replaced by the simulations that originally used them as a referential parallel in order to create a user-friendly interface. They may technically still have an original, but they are artifacts, and are secondary choices for performing the task for which they were created. They are analog alternatives in a landscape where digital is the default. For instance, the envelope icon is commonly recognized as a symbol of messaging. While envelopes still exist and are regularly used, they are no longer the default method of private contact between two people. The same goes for the telephone handset. In contemporary web visual language, an icon of a telephone handset denotes

something related to phone calls. The envelope icon and the telephone handset icon are both representations of functions. These functions were once accomplished by the physical objects depicted in the icons, but the physical objects are now secondary to the digital interfaces. What once was an object within the real has been condensed into an image and a function; the condensed version acts as a replacement for the object itself.

The newer visual language on the web refers solely to parts of the simulation. It has no originals and no basis in the real; it references new things that do not and could never exist in the real. The previously discussed hamburger menu icon is an example of this newer visual language. Another example of an image with no basis in the real is the location pin. The pin was designed specifically for Google Maps in 2005. Today, many variations on this pin exist, but the user can assume that any variation on the image still represents something related to location or maps. The concept of putting a pin on a map is not new, but the specific style of pin that today represents the concept of location did not exist before 2005, and it is that specific style of pin that represents location. In short, this pin has no original and does not exist in the real. Speech bubbles are another element of digital visual language with no original; they are a complex part of digital visual language. While speech bubbles are a long-standing graphic convention, their use in interpersonal conversations, many of which take place in real-time, is something that could not have existed before the web. Speech bubbles as a graphic convention have historically been used in

comics and cartoons; speech bubbles in interpersonal conversations transform conversations and relationships into ready-made graphic images. They include a visual dimension in basic conversation where before there was none.

The pervasive nature of this vast system of simulation means that the aesthetic value of the interface has become more and more important, not just for user engagement but for user trust. Websites need to be credible, and in order to be credible, they need to look right. Research has overwhelmingly found that credibility is often communicated by the quality of design (Choi & Stvilia, 2015). Aesthetics are often perceived as a hindrance to efficiency and a means for designers to express themselves, rather than an important factor in the way users perceive an interface. However, aesthetics are important in every facet of life. The beauty of nature, architecture, people, and even products determines how people relate to, use, and perceive those elements (Lavie & Tractinsky, 2004).

Conclusion

Contemporary interface icons are a dislocated set of visual metaphors that are no longer tethered to the physical world. The current state of aesthetics in web design is due in great part to the erosion of the real in human life. The web looks the way it does today because the simulation has eclipsed the real. Skeuomorphism in interfaces was useful because it was another tool to assist users in contextualizing of a simulation's functions. After a certain point, that contextualization became unnecessary. The simulation rendered those contexts outdated, and skeuomorphism began to depict things that no longer had an original. As users

became more entrenched in the simulation and it began to eclipse the real, designers found the need to depict things that never had an original to begin with. There is a need to depict things that originated in the simulation, because the simulation is now the real. Our changing visual language surrounding symbols and icons have also reflected that evolving need. Users are performing tasks that were created for us by the simulation; this is because the simulation has eclipsed the material tasks that used to make up the framework of human life. Aesthetics relate heavily to trust and credibility. It is in the interest of the simulation to be trusted, and the simulation benefits immensely from being trusted. Without trust, the simulation would not have ever had the ability to eclipse the real. Users need to trust the simulation because the simulation has eclipsed the real so thoroughly that there is no alternative.

In the early days of the web, the language surrounding websites promoted the understanding of websites as spaces. Today, websites have not only asserted themselves as spaces, but have substantially replaced physical spaces. Over time, the functions of daily life and major institutions became centrally located in cyberspace. Social relationships, news, banking, research, music, shopping, dating--every part of life that could happen in cyberspace has moved towards operating primarily in cyberspace. The holdouts are essentially the experience economy (which is a reactive result of the encroachment of cyberspace into every

aspect of life),[3,4] the making and consumption of food, and personal care (both of which are arguably parts of the experience economy). Cyberspace is as present as possible here, but is technologically unable to replace either of these completely as of yet. Computers are no longer a hobby, and they're no longer a digital office. They are a vital appliance that is a functional necessity in the modern world. Such a significant portion of everyday life is conducted in cyberspace that it has become almost impossible to extricate the two. In short, real-world systems have turned into simulations. Websites are signs[5] of the real, but they are not the real.

At this point in time, computing technology has pervaded almost every aspect of life. It has become inextricable from everyday life and is no longer relegated to a certain sphere. In fact, it is difficult to overemphasize the extent to which computing technology composes, and has altered, the framework of everyday life in a society. The web built upon the visual language established by early graphical user interfaces in order to help users understand it and navigate it. However, the collaborative and dynamic nature of the web resulted in the rapid evolution of web aesthetics, from readable and visually interesting pages to high-functioning

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[3] Jean Baudrillard writes, "When the real is no longer what it used to be, nostalgia assumes its full meaning. There is a proliferation of myths of origin and signs of reality; of second-hand truth, objectivity and authenticity. **There is an escalation of the true, of the lived experience;** a resurrection of the figurative where the object and substance have disappeared. And there is **a panic-stricken production of the real and the referential, above and parallel to the panic of material production**."

[4] Akiko Busch writes, "with our cell phones, e-mail, and assorted forms of wireless communication, the elusive corridors of cyberspace have whetted our appetite for what we can touch, hold, taste, see. In the virtual age, the sorcery of the physical has intensified. We become attached to objects out of sentiment, perhaps, or for their symbolic value – a wedding ring, a grandmother's quilt, an old fountain pen, all of which may commemorate personal history."

[5] Signs are anything that communicates a meaning that is not the sign itself to the interpreter of the sign. Intent is not necessary for communication.

interfaces. GUI design was insulated from this quick set of evolutions, and visually developed at a much slower rate. The visual language of today's web is a collection of references that have replaced their referents, and the functions of digital interfaces and the web have begun to overtake the functions of the real. As the presence of digital technology in everyday life not only holds firm but continues to increase, the once-tenuous visual language of user interfaces strengthens and begins to reference itself. Websites begin to reference web-specific visual elements in their visual language. This removes the physical world from the role it has historically played in visual metaphors for graphical user interfaces. Computing and the web become more and more removed from the real, and have substantially replaced many of its long-standing material aspects. The visual language of the physical world constituted the foundations upon which the visual language of GUIs was built, and, over time, the presence and relevance of the physical world has been eroded.

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