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ACM SIGDOC (Special Interest Group Design of Communication) seeks to be the premier information source for industry, management, and academia in the multidisciplinary field of the design and communication of information. It contains a mix of peer-reviewed articles, columns, experience reports, and brief summaries of interesting research results. Communication Design Quarterly (CDQ) is archived in the ACM Digital Library.

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- Experience reports. Experience reports present project- or workplace-focused summaries of important technologies, techniques, or product processes.
- Interesting research results. Short reports on interesting research or usability results that lack the rigor for a full article. For example, pilot studies, graduate student projects, or corporate usability studies where full details can't be released.

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The next generation on design of communication

Liza Potts and Michael Albers

Co-Editors of Communication Design Quarterly

Supporting the next generation of design of communication scholars is a core mission for Communication Design Quarterly. Beginning with this issue, we hope to highlight the exciting research that our younger generations are contributing to the field.

After our most recent conference, we had the opportunity to review the top submissions from our attendees. In discussing these submissions, we decided to focus on student work because of the quality of these materials as well as living up to our mission.

By including these papers, we hope to encourage more submissions from graduate students and early career professionals and researchers. We also hope to encourage others to make way for our upcoming scholars and practitioners. Providing these kinds of opportunities is part of mentoring these designers of communication. And in doing so, we can enrich our own work, learn new techniques and technologies, and continue these conversations in new and inventive ways.

We all would probably agree that computers are digital and that anything provided via a computer must be digital. However, the definitions of digital and analog are themselves not as distinct as we may hope. Rather than sitting at opposite ends of line with nothing in-between, there are a host of analog-like, digital-like or hybrid-like interactive systems which we should pay more attention. As the convergence of computers and everyday objects continues, we will be faced with more and more of these hybrids. The world is inherently analog; once we leave the comfortable confines of the microprocessor, we must confront that analog nature as it interacts with the digital interface. Koh et al consider what we mean by analog-like and digital-like through a host of specific research projects which explores those definitions.

Developmental frameworks can provide a quick way to produce consistent webpage design, two factors which every webpage developer strives to achieve. However, as Lindsley points out, using frameworks without considering the implications which went into their creation can lead to designs which fail to rhetorically meet their intended purpose. Unlike most articles on frameworks, Lindsley addresses their use through a rhetorical lens and how the resulting usability rises and falls based on the considerations (or non-consideration) of rhetorical theory.

Twitter is not solely a stream of "what I'm eating right now." Like all forms of communication, people use the different hashtags for different purposes and different types of communication. Harrison provides a poster where she looked at the tweets on the #HPV Twitter stream and examined the contents of those tweets.

We are also excited to continue to provide CDQ to the community, but we need your help. Part of our mission is to publish new, cutting-edge work that does not normally fit in traditional journals for a number of reasons. We can be a home for articles that:

- Blur the line between being a rhetoric article and an information design or information architecture article and, as a result, are appropriate for neither group of journals.
- Discuss pilot study or early research results. Perhaps you did a pilot study or it was done as a graduate student project. The results are interesting, but clearly need more research before making full claims. But we can provide a communication path to let people know about your work and to help solicit feedback as you more fully develop the project.
- Provide an interesting insights into work-based projects which help us understand the ins and outs of new technologies, techniques, or product processes.

With that, we present the January issue of CDQ. Please feel free to distribute far and wide. And send us your seminar papers, pilot studies, commentaries, and other work that you want to start the conversation. We want more than traditional research articles (although we want those too) because we need to have these conversations in order to innovate and continue do the work of designing communication.

From the SIGDOC Chair

Rob Pierce

IBM Software Group robertp@us.ibm.com

Dear ACM SIGDOC Members,

The 2012 ACM SIGDOC conference was a wonderful and successful event for our organization! Our web site includes a conference recap that includes pictures and recordings:

http://sigdoc.acm.org/sigdoc-2012-recap/

Papers from the conference are now available in the ACM Digital Library.

The conference included a SIGDOC 30th anniversary panel event that included many past SIGDOC chairs and I had the delightful and insightful pleasure of an extended discussion regarding our organization and the current and future relevance and importance of "design of communication" with Nina Wishbow and Diane Paterson, two amazingly intelligent past leaders of our SIG. We also held a "town hall" at the conclusion of the conference - it was well attended and there was much fruitful discussion and input on actions to take to help support our ongoing health and growth.

A German contingent from the University in Aachen expressed interest in hosting a future conference as this was their first SIGDOC conference and they loved it, they said. Another new SIGDOC conference attendee was Jeff Koh, from Singapore. He is now looking to create a new AsiaSIGDOC and attract a new generation of designers of communication.

We also had our annual Board meeting and some of the additional updates for our SIG, that came out of the meeting:

- Revisit and clarify our mission statement. We've updated our mission statement, in large part from meetings and discussions held in Seattle, and your SIGDOC board would like to hear

from you, our members regarding it. See: http://sigdoc.acm.org/about/

- We've expanded the effort to promote chapter and student chapter creation. Our new student chapter leader, Sarah Egan Warren (sarah@warrensweb.com), gave presentations and promoted student chapters at this year's conference.
- We generated a list of candidates who will be running in the next election.
- We have a strategy to try to increase industry participation and will be using our web site to promote these efforts.
- We had some challenging but productive discussions and updates on our future conference plans. We had a plan in place for SIGDOC 2013 to be in Kyoto, Japan, at Waseda University at the request of previous conference attendees. Given our one year ACM viability review status, it was deemed necessary to change that plan and have the 2013 conference be in the United States. Michael Albers offered East Carolina University, checked with his colleagues and confirmed that he had approval. He is going to be the general chair. The conference will be held on Monday and Tuesday, Sept 30-Oct 1, 2013, and more information, including a call for papers will be coming soon.

In the town hall session , attendees expressed that a key distinguishing feature of our SIG has been its not just providing a community where theory meets practice (as in other SIGs) but where theory is applied. The decreasing industry representation at our conferences over the years is reflective of economics but with that said, we have some ideas and plans to try engaging industry such as seeking future conference sites in conjunction with company interest.

We want to all contribute and support SIGDOC to help ensure its ongoing success and viability. Please feel free to contact me and share your thoughts and suggestions.

Thanks for your support!

Rob

SIGDOC 2013 conference

We are pleased to announce that 2013 ACM Special Interest Group on Design of Communication conference will be held in Greenville, NC between September 30th and October 1st, 2013.

Conference chair: Michael Albers. albersm@ecu.edu

Program chair: Kathie Gossett. kgossett@iastate.edu

Visit the website for more details and the complete call for papers: http://sigdoc.acm.org/2013/

SIGDOC presenters cover all aspects of the design of interactive systems and related texts, including those used in industry, recreation, education, science, and social exchanges. Industry and academic researchers are encouraged to submit research papers, experience reports, and interactive posters. Contributions may include studies of design processes, research methods, deployment analyses, and situated use studies related to the design and use of communication artifacts.

Submission types

- Research and technical papers
- Research posters
- Experience reports

Submission topics

Possible conference submissions topics (but not limited to):

- Design for interaction
- User experience methods to support design
- User support systems and documentation
- Open source design solutions
- Collaborative systems
- Human-Computer Interaction (HCI/CHI)
- Computer-mediated communication
- International and intercultural communication design

Characterizing the Analog-like and Digital-like Attributes of Interactive Systems

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Abstract

In this paper we analyze the works of the Keio-NUS CUTE Center at the National University of Singapore in order to uncover the dispositions of "analogness" and "digitalness" in regards to the relationship between users and interfaces. By comparing concepts of embodiment from a philosophical perspective, paired with the computer science treatment of analog and digital data, we derive a contingent definition for analog-like and digital-like interaction. With case studies as reference, we outline a continuum to describe types of interfaces based on these dispositions, which could then be further analyzed using characteristics for designing analog-like, digital-like or hybrid-like interactive systems. We then propose a new methodology for designing novel interactive systems that are analog in nature, called interactive analog media (IAM) and finally describe a prototype system called Linetic, which exemplifies some of the characteristics described in this paper.

Introduction

Since the advent of the lever and button (DeRouchey) we have seen an increasing amount of methods in which users interact with machines. Major breakthroughs in interface development such as tangible user

interfaces (TUIs) (Ishii & Ullmer, 1997), multitouch interfaces (Wellner, 1991), and more recently, organic user interfaces (OUIs) (Vertegaal & Poupyrev, 2008) have afforded new ways for human-computer interaction (HCI) researchers the means to create innovative, interactive systems.

Likewise theories of the relationship between interactive systems and users has been explored though concepts of embodiment ever since Descartes published his Mediations on First Philosophy (Descartes, 2005) right through to Merleau-Ponty and his theories regarding phenomenology (Merleau-Ponty, 2005), to Dourish's incorporation of phenomenology into HCI (Dourish, 2004), and beyond. With the dawn of ubiquitous computing, Mark Weiser attempts to extend this notion of phenomenology with new digital computing technologies. By "weave(ing) themselves into the fabric of everyday life" Weiser tries to bring digital technologies into the analog world around us (Weiser 1991). However, as we move into the 21st Century, a dichotomy between what is analog and what is digital has emerged (Analog/Digital Transaction). This duality provides an opportunity to discuss and analyze interactive systems that have tendencies towards either analog-like or digital-like interaction characteristics, or even a hybrid of both. Here, the duality addresses the relationship between the user and the interactive interface in terms of the action by the user and the reaction of the system and vise versa.

Using case studies derived from the extensive body of published works developed and studied at the Keio-NUS CUTE Center at the National University of Singapore, we discuss in this paper the topic of embodiment within HCI as well as in the humanities. We then outline in this paper the characteristics of "analogness" and "digitalness" regarding the relationship between interactive systems and users. From this point we then define a taxonomy for types of interactive systems (analog-like, digital-like, hybrid-like), and propose a continuum for analog-like-to-digitallike interaction.

By creating the Analogness-Digitalness Continuum (ADC), we can then begin to define a new methodology for designing novel interactive systems based on their analog-like versus digital-like tendencies, and propose a new field of research to counterbalance interactive digital media (IDM) (Pentland et al., 2006) based on interactive analog media (IAM).

The main motivation to create such a method of classification is two-fold. Firstly, the ADC in of itself can be used to study and classify all interactive systems.

Secondly, the ADC in conjunction with the proposed characteristics found in this manuscript can be used to direct development of such systems in order to achieve particular styles of interaction and user/system relationship.

In the next section we present a philosophical overview to the notion of embodiment and its contemporary representation in interactive media. Through this discussion we define "analogness" and "digitalness" for interactive systems. The following section presents a prototypical Example of an Interactive Analog-like Interface, which analyses some well-known works and concepts in interactive systems research, in terms of their analogness and digitalness. We then introduce our grounding characteristics to define the analogness or the digitalness of an interactive system. These characteristics are further expanded and explained in the next section titled characteristics for Defining Systems with Analog-like and/or Digital-like interactions. Next in the Case Studies section we analyze some works of the Keio-NUS CUTE Center, and then move to propose the Analogness-Digitalness Continuum, after which we conclude the paper by inviting researchers and practitioners of all interested fields to further define guidelines derived from the characteristics as outlined in this paper.

On Embodiment

There is no widespread acceptance regarding a universal definition on immersion and embodiment, therefore it is important before moving on to place them into context. As this paper concentrates on human-computer interactions with a special emphasis on their embodied potentialities, embodiment will be referring to a state where one has the ability to interact with a system through an interface, as well as receive and cause stimuli and experiences within a given space. This section will explore the notions of disembodiment and the Cartesian split as well as issues of phenomenology as proposed and discussed by Descartes, Merleau-Ponty and Mark Hansen. The phenomenological theories will then be applied in creating a distinction between the interactions of a user with a digital-like and an analog-like system.

The philosopher René Descartes suggested the idea of disembodiment in the 17th century. In his unfinished treatise *The Description of the Human Body*, Descartes describes the human body as a machine, where heat from the heart causes all the movement in the body. Veins, just like pipes, carry blood from all parts of the body towards the heart, where it serves as nourishment for the heat that is there. He believed that the most agitated and lively part of the blood would be taken to the brain where it would compose a subtle wind, called the animal spirit or the soul, that enabled the brain to experience, think and imagine (Ross, 1975). The soul, according to Descartes, is in fact a separate nonmaterial entity that exists inside and controls the body. This idea had been proposed also by Plato centuries before who believed that the body is from the material world whereas the soul is from the world of ideas, united temporarily with the body and separated at death when it would return to the world of Forms. This dichotomy of the body and soul – commonly referred to as dualism or the Cartesian split – serves as the basis for modern ideas about disembodiment, inhabitation of virtual avatars and transfer of consciousness from one body to another.

Jacquelyn Ford Morie, looking at immersion from a phenomenological point of view, argues in her paper Performing in *(Virtual) Spaces: Embodiment and Being in Virtual Environments* that "VEs engage the body as kinesthetic input via the specialized interface devices that not only permit but require bodily actions to be performed sensorially, kinesthetically and proprioceptively – within a full 3d spatial yet virtual construct" (Milgram et al., 1994). She goes on to mention that since the VR equipment mediates our perception, we must try and understand what constitutes a mediated environment.

The French phenomenological philosopher Maurice Merleau-Ponty on the other hand, views the phenomenal body as our primary access to our reality. Even though there are several approaches to phenomenology, Merleau-Ponty views the individual and the world not as part of a whole but rather as separate entities subjected to the phenomenon of the individual. Hansen, in his book *Bodies in Code* celebrates and expands this idea to the domain of new media art (Hansen, 2009). He argues that technologies can change or enhance our sensory experiences consequently affecting our view of embodiment. Wanting to move away from what he calls "the clichés of disembodied transcendence" Hansen envisions a world with a fluid interpenetration of the virtual and the physical realm (Hansen, 2009). Deriving his theories from Merleau-Ponty's notion of

"reversibility" and the idea that the body has an ability of inverse sensorial duality (for example, it can see and can be seen), the main focus of Hansen's book is how vision needs to be combined with touch in order to shorten the gap between ocularcentrism and a body's inherent simultaneous multi-sensations.

Going a step further, Hansen argues "Motor activity" – not representationalist verisimilitude holds the key to fluid and functional crossing between virtual and physical realms. According to Hansen the success of generating compelling virtual experiences comes not from representational aesthetics but rather by simulating tactile, proprioceptive and kinesthetic sense modalities. Expanding on a theme addressed in his previous book *New Philosophy for New Media*, Hansen couples the sense of reality with touch and the perception of spatial depth and argues that by including bodily movement the formula has enough elements to "synthesize" the other senses; therefore perception is transformed into experience. He calls this notion Mixed Reality and defines it as "The eschewal of representationalism and embrace of a functional perspective rooted in perceptuo-motor activity" (Hansen, 2009).

In HCI, the controls of an analog interface can be directly integrated or expanded into a perceptuo-motor activity, as there is no technological mediation between the interface and the system. Digital interfaces on the other hand are not a direct result of "the organism within" but rather on the representation of the action as mediated by the technology (what Merleau-Ponty refers to as the body image).

Hansen, in his first chapter in *Bodies in Code* defines Merleau-Ponty's body image and body schema as "…The body image characterizes and is generated from a primary visual apprehension of the body as an external object, the body schema emerges from what, with autopoietic theory, we have called the operational perspective of the embodied organism" (Hansen, 2009). Merleau-Ponty offers an account of the body schema as "a flexible, plastic, systemic form of distributed agency encompassing what takes place within the boundaries of the body proper (the skin) as well as the entirety of the spatiality of embodied motility". In other words the body image refers to how the body is represented whereas the body schema refers to the organism within, which is caused by movement and subsequently causes it (Merleau-Ponty, 2005). As Hanson phrases it: "Because it is responsible for linking proto sensory bodily sense

(proprioception) with perception and motility the body schema is a source of embodied potential" (Hansen, 2009).

Discussing along the same lines, Brian Massumi in his book *Parables for the Virtual* argues that the digital realm has potentiality but what really produces the possibilities (which he calls inventions) is the analog. "Whatever inventiveness comes about, it is a result not of coding itself but of its detour into the analog. The processing may be digital – but the analog is the process. The virtuality involved, and any new possibility that may arise, is entirely bound up with the potentializing relay. It is not contained in the code" (Massumi, 2002).

As this paper is mainly concerned with the user experience and the embodied interaction between a user and a system, a clear differentiation can be noted between a user interacting with the body schema and one that is not. When an action comes from "within one's organism", as a direct continuation of an embodiment in space, it becomes intuitive and analogous to the data it represents. When the interface is of a digital form, the action does not flow naturally but rather is broken down and rebuilt in a discrete manner dependent on the rules specified by the mediated technology, resulting into a dichotomy of the embodied potential and the intended result.

With this established, we now look to computer science and engineering for another dichotomistic definition in which the above discussed ruminations regarding embodiment can be synthesized with. By drawing comparison between a philosophical treatments of what is analog and digital and the computer science attitude towards analog and digital data (data being the embodiment of information with which a user can manipulate and interact with), we can attempt to define analogness and digitalness within the context of HCI.

Defining analogness and digitalness

In the past, philosophers such as David Lewis discussed the troublesomeness of distinguishing analog and digital classifications (Lewis, 1971). He mentions that even though it is relatively easy to make the distinction in practice, the analysis of such representations from a philosophical standpoint is difficult.

Yet from a computational standpoint, the distinction is much more defined. Dale and Lewis attempt to describe analog and digital data:

"Analog data is a continuous representation (as represented in Figure 1), analogous to the actual information it represents. Digital data is a discrete representation (as represented in Figure 2), breaking the information up into separate elements." (Dale & Lewis, 2002).

From Dale and Lewis' definition in comparison with concepts of embodiment discussed in the previous section of this paper, we can derive and adapt our own definition for analog-like and digital-like interaction:

Analog-like interfaces create a continuous experience for both the user and the system, analogous to the actual information it represents. Digital-like interfaces create a discrete experience, segregating the users' interaction with information and the system's interaction with the user into separate events.

Adopting this definition helps us outline the differences between interactive systems and highlight features that are disposed to analog-like versus digital-like tendencies when representing interactive content to users. The differences can then become identifiable characteristics that could help in the development of interactive systems, which are discussed in detail later on in this paper. Yet before continuing, an analysis of well-known HCI projects using the above-proposed definition should be made.

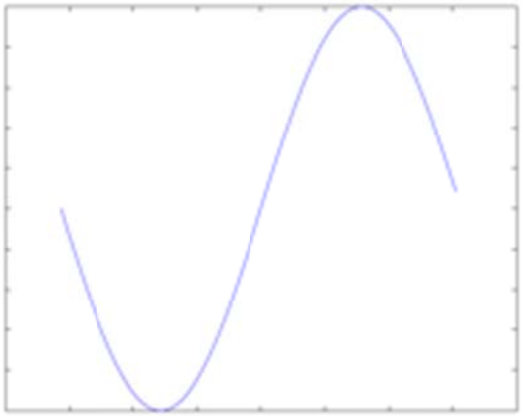

Figure 1. A continuous, analog signal.

Figure 2. A discrete, digital signal.

A prototypical example of an interactive analog-like interface

Adhering to this early classification of the digitalness and analogness of interactive systems, we investigate Ishii's work on Tangible Bits (Ishii & Ullmer, 1997), in this context. We investigate the work presented in Tangible Bits due to its wide acceptance as the work that defines the notion of "tangible bits". Furthermore, to our understanding, this work contains both digital-like and analog-like affordances that would help us to define the true digitalness or analogness of interactive systems.

Tangible Bits represents a wave of new interface technologies that lets users grasp and manipulate digital information. Thus, the work here mainly focuses on the interface aspects of the interaction. In completing the equation, this paper introduces the user into the scenario and addresses her involvement with the interface, the interaction and the embodiment of these aspects with relation to the user.

The vision of tangible bits is introduced through the three main design projects of metaDESK, transBOARD and ambientROOM. These projects present various ways of representing digital information through tangible objects. Thus here, we analyze some of these interfaces and interactions in terms of their digitalness or analogness.

In the metaDESK, there are few tangible objects such as the "phicons", etc. which represents various interactions for the user. They are used on a tabletop setting to which the graphical user interface is projected on to the

surface. The user interacts with this graphical user interface (GUI) using tangible objects. Here, the phicons are picked up, placed, rotated, etc. by the user on the tabletop. These various actions represent various reactions such as identification, rotation, zooming and so forth in the GUI. Thus, these intuitive actions that we would use on such a tangible object represent the interactions with the system. In addition, the interaction is continuous, as we would interact with a tangible object, without having to follow a discrete set of steps. Thus, the actions are embodied within the object or the interface. Hence, the phicons interface contains analog-like characteristics.

However, the output of the system here is a projection onto the tabletop. According to our earlier discussions this creates a dichotomy between the interface and the media, as it is not combined in a singular fashion. The interface (in this case, the table) does not have any particular representation of media or content. Thus simply changing the table to a wall would not have any effect on the media or the content, as it is a digital representation that is displayed as the output. This disconnection we see as a main characteristic of a digital-like system.

These key characteristics are seen in some of the early works of tangible user interfaces. In (Ishii & Ullmer, 1997) again, similar to TUI's, physical pucks are used on a "sensetable" as the input devices. By relocating and rearranging these pucks the user can change various parameters of the system that is visualized through the output image projected onto the table. Here too, the use of physical pucks and their various orientations are intuitively engineered. This can be seen as an intuitiveness that leads to continuous interaction with this interface. In other words, the change in the orientation of the puck directly changes the parameters and causes a continuous interaction. However in contrast to this analogness of the input, in terms of the output of the system, once again, the projection creates a dichotomy between the projected content and the interface. The projection is not defined by the interface. Even if the interface was a scroll button of a mouse, or the output surface was a tabletop or a wall the projection is unhindered. As mentioned before this discontinuity or the discreteness between the output and the interface becomes a characteristic of a digital system.

This use of analog-like characteristics and digital-like characteristics presents a hybridized architecture for these technologies. This is one of the key characteristics of tangible user interfaces where the focus is mainly on

the tangibility of the interface rather than its form or function. In addition, it only focuses on the interface and limits its involvement of the user and her role in the interface. Thus, the analog-like and digital-like characteristics are mixed more often in these technologies.

Thus moving ahead from tangible user interfaces, researchers of more recent fields like organic user interfaces started refining the characteristics of the interface itself (The et al., 2008). Adhering to the three tenants of OUI's, input equals output, form equals functions and form follows flow, OUI's focused on the ergonomics of the interface to define its function and interaction. Thus, textiles, paper, and many other forms of flexible daily objects have become interfaces. Consideration of the ergonomics of the objects helps the interfaces to encompass more analog characteristics to its design. However, here too the lack of consideration of the user's involvement of the design of the interaction process has led to these systems to be more hybrid in nature as well.

For example, many of the recently developed fabric displays too fall under this category of organic user interfaces. However, there is a keen interest in combining media such as light emitting diodes (LEDs) and electroluminescence materials (Co & Pashenkov, 2008). Thus, in the context of an embodied interface, such displays or interfaces fall short of using extended characteristics of the textile itself and rather superimpose a foreign object or material creating a vivid dichotomy between the material and the interface. Hence, the user's interaction is in fact with the LED or the EL wire, which represents the digital information and not the actual "fabric" itself as an interface. Therefore, the extension of the interface is to a foreign material making it more digital-like in nature.

Analyzing these concepts such as tangible user interfaces and organic user interfaces makes it clearer that most of these concepts focus their definitions towards the interfaces themselves. Thus, in determining the analogness or the digitalness of the interface and more importantly the interaction, we stress the importance in considering the user and the extension of user's notion of embodiment towards the user interface. Just as Mark Weiser depicted that "the most profound technologies are those that disappear" (Vertegaal & Poupyrev, 2008), the extension of the interface and more importantly the interaction as a single embodiment becomes important throughout the definition of the analogness and the digitalness of the interface and the interaction. Thus, in defining these

characteristics and analyzing the previous concepts, we identify the following main points to define these characteristics:

- Analog-like interactive systems: Content and media are singular in embodiment
- Digital-like interactive systems: Content and media are dichotomistic in embodiment
- Analog-like interactive systems: Interaction is continuous
- Digital-like interactive systems: Interaction is discrete
- Analog-like interactive systems: The interface is intuitive
- Digital-like interactive systems: The interface is mediated
- Hybrid-like interactive systems: fUlfills some or all of the afore mentioned rules

Characteristics of systems with analog-like and/or digital-like interaction

Analog-like interactive systems: Content and media are singular in embodiment

Just as analog data in a computational system can be described as analogous to the actual data it represents, so do analog-like interactive systems represent data to users as a singular embodiment where content and system are one and the same.

Digital-like interactive systems: Content and media are dichotomistic in embodiment

In digital computational systems, data is represented discretely, breaking up information into separate elements. A digital-like interactive system therefore separates content and interface so that data delivered by the interactive system can be changed and replaced by different data. Content and media are therefore mutually exclusive and represent two separate embodiments.

Analog-like interactive systems: Interaction is continuous

Much as analog data is a continuous and infinite representation, so is the interaction method in analog interactive systems.

Digital-like interactive systems: Interaction is discrete

In digital computational systems, data is finite and compartmentalized into limited data sets. Therefore digital-like interactive systems are precise in their interactions, meaning that there is a limited selection of variables when interacting with the system.

Analog-like interactive systems: The interface is intuitive

From a user standpoint, analog-like interactive systems feel natural to use. They are extensions of the body and when used, become part of the embodiment of the user.

Digital-like interactive systems: The Interface is mediated

Digital-like interfaces are always accessed through a discrete interface method or technology. Users must use a tool with a precise function and method of use in order to interact with the system.

Hybrid-like interactive systems: Fulfills some or all of the afore mentioned rules

Hybrid-like interactive systems exhibit some or all of the characteristics of both analog-like and digital-like interactive systems.

The characteristics of systems with analog-like and/or digital-like interaction can be used as a lens to analyze the relationship between interactive systems and users. In the following section, we will attempt to differentiate projects by their analogness and digitalness by applying the characteristics to a series of case studies.

Case studies

In this section we will analyze six existing interactive systems from Keio-NUS CUTE Center, in the context of interactive analog and digital media. By apply the rules described in the last section, we divide these projects into three main categories: analog-like, digital-like, and hybrid.

Analog-like relationship between user and system

In this section we discuss projects with analog-like characteristics by looking at the Living Media and Huggy Pajama projects.

Living Media (Cheok et al., 2008b) is a new form of interactive ambient media using living organisms to communicate social, human or ecological

information, such as the status of health, environmental pollution, and remote interactions between friends. As shown in Figure 3, in a Living Media system, information is semantically coupled into a living plant, in this case cabbage.

Situating Living Media with the proposed characteristics, it can be seen that Living Media communicates information through the intrinsic properties of living creatures, such as shape-changing and color-changing characteristics. Therefore the content and the media are naturally singular. In terms of the continuousness of user interaction, Living Media using cabbage to perform the output with the slow and gradual change of color under chemical solution with different pH values. Furthermore, the input information is from the natural environment, which is continuously changing; this also implies that there is no limited or specific set of input data for the living media, which means users can map any type and range of variable to ambient Living Media. In addition, the results of a user study for Living Media shows that it is visual and easy for user to understand information data through, and generate empathy for natural living creatures. Therefore, Living Media falls in the category of analog-like interface.

Figure 3. One of the Living Media projects, Babbage Cabbage was demonstrated at Laval Virtual 2009 in Laval, France.

Huggy Pajama (The et al., 2008) is a wearable system to allow parents and children to communicate over the Internet by physically hugging each other through a novel hugging interface. A demonstration and user study of the system is shown in Figure 4.

In the Huggy Pajama system, the pajama with embedded actuators generates the remote physical hug. Without wearing the pajama, users cannot experience the remote hugging interaction, which means the hug sent through the Internet cannot be separated from the pajama. The input data for Huggy Pajama, such as touch and pressure, are continuously sensed in a wide range by the embedded Quantum Tunneling Composite (QTC) circuits. On the other side, the air pressure in the pajama changes slowly in a continuous way under a closed-loop controlling system. According to the user study, users showed interest to use Huggy Pajama to hug each other remotely, and it doesn't take effort to use the interface, as only touching input is required. With this analysis, we categorized Huggy Pajama as an analog-like interface.

Figure 4. User study and demonstration of Huggy Pajama in Singapore, 2010.

Digital-like relationship between user and system

In this section we discuss projects with digital-like characteristics by looking at the Poetry Mix-up and Confucius Computer projects.

Poetry Mix-up (Fernando et al., 2009) is an extension of the existing text-messaging paradigm to a new level of self-expression and cultural communication, combining visual art and poetry. Mixing and generating poetry based on users' input messages is the major element of this system, which transforms the users into experiencing the state of being a poet. An installation of Poetry Mix-up is shown in Figure 5.

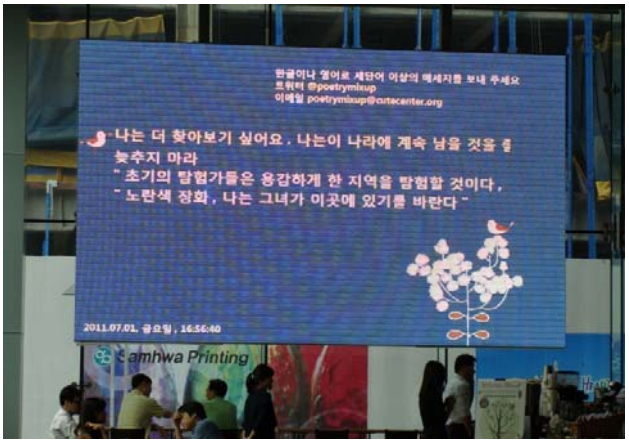

Figure 5. Poetry Mix-up demonstrated at Art Center Nabi in Seoul, South Korea in 2011.

In the context of interactive analog media and digital media, in Poetry Mix-up the generated poems that are finally displayed to the public are stored in a database. Therefore, the stored poems are not bond to any specific media, such as workstations, displays and messaging devices. In addition, the poem is generated in a set of discrete steps using natural language processing, and mobile communication devices mediate the interaction. Therefore, we can argue that Poetry Mix-up is a digital-like media.

Confucius Computer (Cheok et al., 2008a) is a new form of illogical cultural computing based on the eastern philosophy of balance and harmony. The system enables users to have meaningful chatting with a virtual Confucius, as shown in Figure 6, to explore the Confucius philosophy, and even solve personal problems on occasion. Similar to Poetry Mix-up, it employs extensive advanced information retrieval and natural language processing techniques.

Therefore, Confucius Computer shares similar characteristics with Poetry Mix-up. It does not attach to any special hardware, and is available online. The virtual Confucius generates a related reply from analects in a series of discrete steps. As well as being mediated by the traditional computer interface, Confucius Computer can be also categorized into digital-like media.

Figure 6. A screenshot of the Confucius Computer chat interface.

Hybrid-like relationship between user and system

In this section we discuss projects with hybrid-like characteristics by looking at the Metazoa Ludens and Age Invaders projects.

Metazoa Ludens is a revolutionary system that enables humans to play computer games with small animals in a mixed reality environment (Tan et al., 2008). In this system as shown in Figure 7, the human user controls a movable robotic arm through a virtual reality game where the robotic arm is represented as a human avatar. The virtual-reality game is not bound to any special computer, and is mediated by the keyboard interface. On the other hand, for the pet user, within the large running environment, it chases freely and continuously after the robotic arm and the pet itself is the content and the media during the interaction, as its body is captured and recognized by the camera. In addition, based on the user study of the desire for pet to play this system, the pet hamster showed great interest in chasing the physical robotic arm. Therefore a mixture of both analog-like and digital-like media is shown, which makes Metazoa Ludens a hybrid-like interactive system.

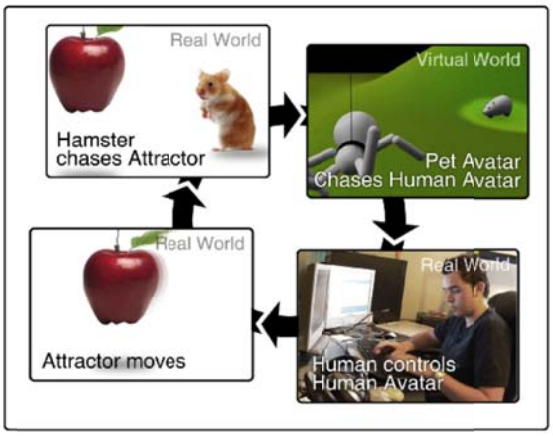

Figure 7. Hamster-Human interaction in Metazoa Ludens.

Age Invaders (Figure 8) is a novel interactive intergeneration physical game that allows the elderly to play harmoniously together with children in physical space, while parents can participate in the game play in real-time through the Internet (Khoo et al., 2006).

Figure 8. Elderly users of the Age Invaders interactive, physical game system.

With the similar features of mixing physical reality and virtual reality as found in Metazoa Ludens, users can perform free and continuous play with their body using gestures and movement on the interactive floor, which senses the users' positions. Other users can also interact with

players on the computer screen in virtual reality. Therefore, Age Invaders provide a hybrid relationship between users and media.

In summary, Living Media and Huggy Pajama fulfill all the features of analog-like media while Poetry Mix-up and Confucius Computer fall into the digital-like media category. Metazoa Ludens and Age Invaders provide a hybrid-like media experience for the user. Therefore, we can use the characteristics for analog-like and digital-like interaction to analyze and exam all interactive systems. This can also be used to develop digital only interaction (interactive digital media), or analog only interaction (interactive analog media). The analysis of case study projects is summarized in Table 1.

The analogness-digitalness continuum (adc)

Similar to the Virtuality Continuum concept proposed by Paul Milgram (Milgram et al., 1994), the Analog-Digital Continuum (or ADC) attempts to describe the continuous relationship of attributes in an interactive system, which could embody any combination of digital-like to analog-like qualities as described in the previous section, Characteristics of Systems with Analog-Like and/or Digital-Like Interaction. The ADC is meant to encompass not just the type of interaction an interactive system provides, but also the method of the embodied relationship between system and user. It therefore differs from other continuums in such that it not only represents the external world, as does the Virtuality Continuum describes, but also the intimate relationship of person and machine. The ADC can therefore be utilized with any HCI implementation when concepts of embodiment and human-factors are involved.

The main motivation to create such a method of classification is two-fold. Firstly, the ADC in of itself can be used to study and classify all interactive systems.

Secondly, the ADC in conjunction with the proposed characteristics found in this manuscript can be used to direct development of such systems in order to achieve particular styles of interaction and user/system relationship.

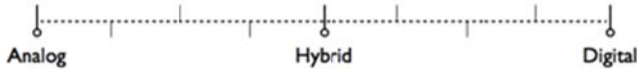

Figure 9. The Analogness-Digitalness Continuum (ADC).

As depicted in Figure 9, the ADC offers two polarizing dichotomies. On one end is the Analog descriptor. This represents systems with completely analog relationships with the interacting user. On the other extreme, completely digital-like interactive relationships between the system and user are represented. Varying scale points between both positions qualify a systems' interaction as hybrid. Depending on how analog-like versus digital-like a system interaction could be would govern its tendency to lean towards a particular polarity on the scale. Discerning the position is measured by scoring a system in relation to the proposed rules, as described by the characteristics of analog-like and/or digital-like interfaces, previously presented in the paper.

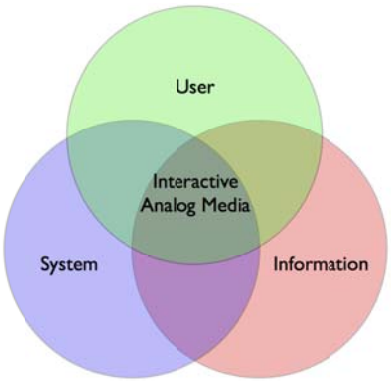

Figure 9. User, system and data as a singular embodiment.

Table 1. Summarization of project analysis in the context of analog-like and/or digital-like interaction.

The Interface is Intuitive	Interaction is Continuous	Content and Media are Singular in Embodiment	System	Content and Media are Dichotomistic in Embodiment	Interaction is Discrete	The Interface is Mediated
X	X	X	Living Media			
X	X	X	Huggy Pajama			
			Poetry Mix-up	X	X	X
			Confucius Computer	X	X	X
X	X		Metazoa Ludens	X		X
X	X		Age Invaders	X	X	X

On interactive analog media (IAM)

By clearly defining what it is for an interface to have notions of analogness and digitalness, a sub-field of interactive media has emerged. By taking the *Characteristics of Developing Systems with Analog-Like and/or Digital-Like Interaction* into account when developing interactive systems, interactivity of a purely analog-like nature can now be specifically designed. From this point the authors propose a new area of research; that of one that takes into account the analogness of interactive systems in order to develop truly continuous and intuitive interfaces that are wholly one with the user and the data it presents as a singular embodiment (Figure 9).

In an era where media has increasingly become digital, the desire for analog-like interaction with the world around us becomes more desirable. The authors hope that the proposed field of IAM will elevate ubiquitous computing as a mainstay for human-computer interaction in our everyday lives.

The linetic system

With advances in technology pushing the boundaries in regards to the materials used to create ubiquitous interactive systems (Weiser 1991), it is now possible to expand the computer into the everyday environment through softer, and flexible formats. Using these materials and technologies, and guided by the characteristics of analogness & digitalness outlined above, this section presents the implementation of an innovative OUI system based on liquid. This interface explores the potential of liquids as an interface and display device, where the manipulation of liquid becomes both the input and output. Linetic can provide the user with a natural and fluid experience where three-dimensional, tangible interaction takes place.

Linetic provides an input/output solution based on ferrofluid. Ferrofluid is essentially a liquid that reacts to magnetic fields. The system is composed of a pool of ferromagnetic liquid combined with a sensing and actuation mechanism. The sensing uses an array of Hall Effect sensors that measure the density of a magnetic field, while actuation is produced by an array of electromagnets. Sound generation using a MAX/MSP patch running on a connected server augments the output experience.

Wearing a set of magnetic rings, the user can interact with the ferrofluid. The magnetic ring position is detected by the array of Hall Effect sensors, which in turn actuates the electromagnets and the sound server. The magnetic field of the active electromagnets

produces the morphing of the ferrofluid to create transitional physical buttons in conjunction with the gesture, which then generates a sound. At the same time the pulse of the matching polarity electromagnets produces a force feedback vibration on the rings, giving the user haptic feedback.

Through natural movements of the hand, the interface is able to morph from a two-dimensional surface to a three-dimensional form fluidly and dynamically. Using the shape changing quality of ferrofluids, we were able to study how liquids could become a novel form of OUI. In sum Linetic provide a tangible, multi-touch interface with haptic feedback that produces a real 3D morphing surface.

User interaction methodology

In regards to the user interaction methodology, we attempted to simulate some interactions that reflect both the aesthetics and playfulness of interacting with fluid.

Due to the messy nature of ferrofluid as well as the nature of sensing inherent to the system, we decided to employ a finger accessory that allowed users to interact with the fluid without actually touching it. This reduced the methods of interaction to that if simple mid-air gestures. These gestures included waving and tapping. Like-polarity between the surface and fingertip magnets allowed a force resistance that made tapping a particularly compelling interaction.

Later on, we decided to remove the haptic subsystem in order to concentrate on the visual and audio effects of the system. This led us to the third iteration of the Linetic system. With this system, we conducted the following user study.

Method & user study

For the third iteration of the system, a preliminary field test was performed in order to better understand the usability and to also inform us on the possible challenges and limitations of studying the usability of such a unique system. We attempted to measure three items with this study. Firstly, we wanted to understand if gender affected the overall

success rate users could achieve when asked to perform precise tasks using the interface. Secondly, we wanted to see if the user's performance improved through repetitive use. Lastly, we wanted to gain knowledge in regards to the experience of the user when interacting with the system. To find answers to these three questions, we analyzed task success data recorded by the system during the performance of tasks by the users, and then asked users to answer a Likert-style questionnaire upon completion of the tasks.

With the display and input functionality of the system in mind, a simple task was designed. Users were briefed to watch a sequence of ferrofluid buttons activate and were then asked to replicate the sequence in the same order by using the mid-air gesture of pressing. Two practice rounds were allowed before data recording for the study was conducted. Two sequences of 3 patterns each were played and then mimicked by the user. The success rate of the user performing the task was recorded by the system. Both a preliminary ethnographic survey as well as a self-reporting, Likert-style post-task surveys were performed.

Experiment setup

For the purpose of this user study, the system was configured without haptic feedback, as seen in Figure 10. This was done by replacing the normal sensing subsystem of Hall Effect sensors with that of camera vision. We also created a new container that covered and housed the ferrofluid. We configured the systems as such in order to make sure that the liquid would not stain the participants' clothing.

Figure 10. Version Three of the Linetic system without the splash cover.

Once the preliminary ethnographic survey was completed, participants then stood in front of the system with a researcher monitoring their performance. The assigned researcher would explain the system and task during the practice rounds and would refrain from helping the user during the actual test. The computer automatically recorded the success/failure results of the user during the experiment.

Once the test was finished, users were then brought to another researcher manning another station. At this station a computer with a self-reporting survey was presented. Users were then asked to fill out the survey, thus completing the user study. Photos of the user study setup and some of its participants are depicted in Figure 8.

Participants

As this preliminary user study was conducted not only to gain an understanding of the usability of the system but to also inform us on the possible challenges and limitations of studying the usability of such a unique system, participants were sourced using an accidental/convenience sample model. Twenty participants (10 male, 10 female) were chosen for the study, consisting entirely of students and staff from our laboratory. Figure 11 represents some of these participants. Because each participant (mean age=27.8, SD=3.8) works in some way or another within an engineering laboratory as either a researcher, student or support staff, each test subject has had experience participating in studies for the testing of interactive systems. However we did make sure that each participant did not have any experience using the Linetic system. In effect, this was the first time each test subject has used the Linetic system.

Figure 11. User study participants using version three of the Linetic system.

Results and analysis

All data was analyzed using StatSoft Statistica and was checked for normality using KolmogorovSmirnoff test for normality and ShapiroWilks W test.

The first result of the experiment is the effect of gender on the number of correctly performed tasks using the Linetic system. Female participants completed on average of 65% of tasks successfully. Male participants completed on average 68.7% of tasks successfully. These statistics are represented in Figure 12. An ANOVA showed that gender holds no significant effect ($F(2,20) = 0.18$, $p < 0.6$) in regards to using the Linetic system for the specified tasks.

In terms of learning curve between the first set of three tasks (tasks 1 to 3) and the last set of three tasks (tasks 4 to 6), users performed better during the second set of tasks. For the sum total of all participants, users performed an average of 13.7% better during the last three tasks compared to the first three tasks. An ANOVA showed that performance does indeed improve as users familiarize themselves with the system to significant effect ($F(2,20) = 4.3$, $p < 0.04$) when comparing the first set of tasks performed to the second set of tasks performed. This shows that through familiarization of the system, user accuracy increased. These statistics are represented in Figure 13.

The final, post-questionnaire included a number of statements that were presented to each user, posed in the Likert style. Some of these were:

- I thought Linetic was easy to use (over 50% of participants rated the system 3 or higher, 1 being hard to use and 5 being easy to use).
- Linetic has a very attractive presentation (100% of participants rated the system 3 or higher, 1 being not at all attractive and 5 being very much attractive).
- The content of the interface is clear and simple to understand (5% of participants rated 2 or lower and 95% or participants rated 3 or higher, 1 being not at all clear and simple and 5 being very much clear and simple).
- The content is easy to understand and follow (5% of participants rated 2 or lower and 95% rated 3 or higher, 1 being not at all easy to understand and follow and 5 being very easy to understand and follow).

- I found what I was looking for quickly and easily (10% of participants rated 2 or lower and 90% of participants rated 3 or higher, 1 being not at all and 5 being very much).

In analyzing the data, we learned a number of key lessons. As a system, we found that users were more involved when free-playing with the material aspects of the system then when using the system to perform tasks that required specific accuracy. As a logical information system, Linetic fails to provide the precision that more concrete representational systems provide. We also found that due to the limited input and display capabilities of the system, users could use the system quickly but more complex interactions were limited. The reason for this is most likely the combination of the simplicity of the metaphors used in the system, as well as the design of the task users were asked to perform. Still even with these limitations outlined by users in the self-reporting survey, user unanimously enjoyed playing with the system despite its technical limitations.

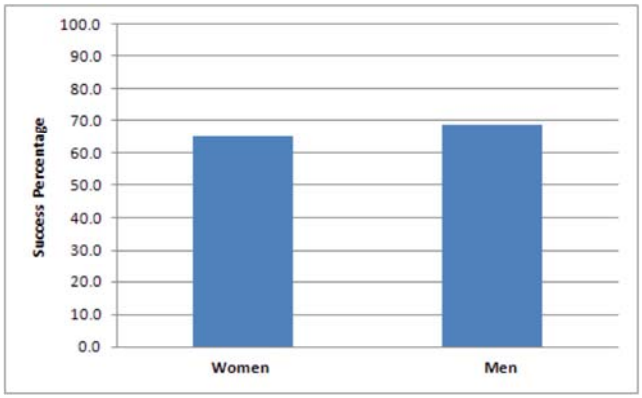

Figure 12. Female versus male average overall performance.

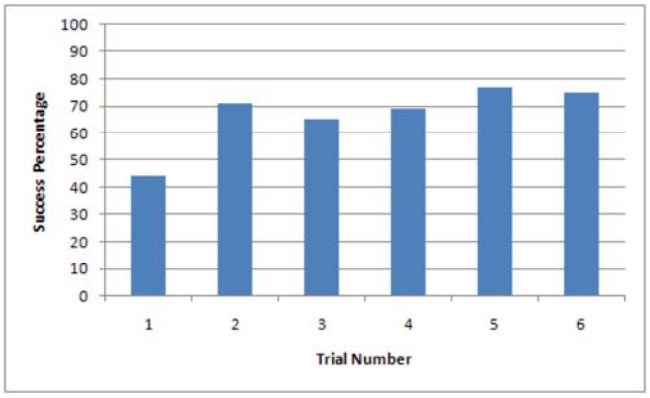

Figure 13. Average performance over all six task trials.

Conclusion

In this paper we presented characteristics in which interactive systems can be defined and developed, possessing aspects and characteristics of digitalness and analogness with specific regard to the relationship and embodiment of the user and system in mind. This was achieved by first discussing theories of embodiment from a humanities perspective, and how it could relate and be integrated with computer science and engineering by defining what it is for data to be digital or analog.

We then attempted to integrate both concepts into a new definition of analog-like and digital-like interactivity with the presentation of characteristics for interactive analog and digital media and through the analysis of a prototypical example of an interactive system.

We further supported these characteristics by analyzing published research projects from the Keio-NUS CUTE Center in the National University of Singapore as case studies, and categorized each project in relation to this.

We go on to present the Analog-Digital Continuum (ADC) in order to easily plot and classify interactive systems depending on their analogness or digitalness.

Later, we propose a new field of research that looks to develop the analogness of interactive systems called interactive analog media (IAM).

Finally we outline a system prototyped called Linetic, which was developed with the characteristics of snalogness & digitalness in mind. We also discuss the results from a preliminary study.

The presentation of this paper is by no means meant to be steadfast when describing interactive systems that possess digital-like and/or analog-like characteristics. On the contrary, the authors hope that the contents of this manuscript creates discussion and dialog between researchers, theorists and practitioners of all disciplines ranging from the sciences to the humanities, who are concerned with the analysis and application of interactivity and embodiment. We invite the wider community to challenge, refute, alter and augment our characteristics with the belief that they can be better defined for the benefit of all.

Acknowledgements

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Prefab Interface Development and The Problem of Ease

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To elaborate on a recent tweet by Dan Cederholm of the development studio, SimpleBits, and author of the standards-focused *Bulletproof Web Design*, current web development practice, with its many device, format, and user contingencies, is creating an ever-expanding and increasingly complex geography for novice web writers and developers to navigate and learn. For a novice to output the ceremonial "Hello world" in 2013 is to greet a world of web writing barely comparable to the inline-styled, table-formatted, and JavaScript-leery World Wide Web which many veteran developers first learned.

Within the past ten years, many ad-driven services such as Blogger and WordPress.com have eased users into web "development," taking most of the work out of site creation by providing WYSIWYG content editors and plug-and-play stock themes for easy content creation and styling. For users, the benefits of these services range from no-cost hosting to ease of a flattened learning curve. And while these services continue to hold prominence among new web writers, there is an increasingly public push for young professionals and students to learn how to program and develop literacy in the base languages of the web. The most public example of this promotion of code literacy has occurred in the exploding enrollment numbers of those taking programming and web writing lessons from Massive Open Online Courses (MOOCs) such as EdX and Codecademy (Wortham, 2012). Even New York City Mayor, Michael Bloomberg, famously proclaimed that his New Years Resolution for 2012 was to learn how to code with Codecademy.

Yet with the need to master syntax, web standards, accessibility, and browser compatibility issues, becoming a competent developer

can take years. Fortunately for those new to web development, many open-source communities and individual developers have created front-end development frameworks, code libraries, and a wealth of custom plug-ins that aid developers in the rapid development of software and website interfaces that meet the aesthetic and functional standards of the most current web trends. Many of these frameworks rely on APIs (Application Programming Interfaces) that simplify multiline functions for interface interactivity into single word calls from the script line, retrieving prefabricated functions from a code library. Essentially, a combination of an API-accessed code library and open-source and publicly available plug-ins creates a coding experience that allows a developer to rely heavily on the existing functions and hooks a within a framework, while avoiding the burdensome task of rewriting simple animations, data queries, and output loops.

While using frameworks and compatible plugins is in the interest of ease and efficiency, novice interface developers risk relying too heavily on the prefabricated work of others, ceding agency, and context-based decision making to the community or developer responsible for the reused code, a user experience focused more on ease than skill, what Bradley Dilger terms “extreme usability” (Dilger, 2007). Additionally, such a practice allows a novice to be unaware of larger cultural or functional contexts within which the technology was developed. Ancient rhetoric, specifically with its concepts of the topoi and commonplaces, provides a heuristic for understanding the communicative dangers of relying too heavily on context-absent code and can also guide the vetting process of a novice developer choosing to use plugins from the myriad resources available on the web.

This paper examines the practice of using front-end web development frameworks and associated plug-ins to develop web application interfaces and suggests returning to a rhetorical foundation for determining the propriety of code use and vetting of an open-source community's plug-ins. Additionally, this paper asks developers and those teaching future web writers to further problematize development framework usability and its implications for designer judgment and agency.

Frameworks

Broadly defined, development frameworks are "a set of tools, libraries, conventions, and best practices that attempt to abstract routine tasks into generic modules that can be reused" in the process of application development (*this paper considers web frameworks specifically, though there are many development frameworks for software as well) (Croft, 2007). Some frameworks such as Bootstrap and jQuery Mobile are specifically front-end or client-side frameworks whose sole purpose is to abstract routine "presentation" code into modular chunks of information that allow for quicker building and greater replication. Other web development frameworks such as Zend, Rails, and CodeIgniter provide libraries and abstracted routines for server-side programming, or the functional part of the web application that processes, stores, and outputs data. Partially a result of the web-standards movement, and partially a result of a need for efficient and expedited coding, both front-end and back-end development frameworks are providing powerful standardization of common web writing practices. An example of a framework's expeditious power can be explained in terms of quantity of work: while it might take a developer twenty lines of code to program, from scratch, a common function for animating an accordion-style registration form, a framework could provide a simple HTML-class or JavaScript API that serves as mechanism of communication that hooks into the framework's library and allows the developer to call the same function in often no more than two lines of code or markup.

Additionally, most frameworks offer a collection of "plug-ins" or the ability to grab snippets of script from the web and hook into the framework's existing code library. A quick Google search for open-source interface development plugins such as image galleries, styled forms, or animated navigation menus yields hundreds of websites offering tutorials and downloadable plugins—of varying quality—for quick integration with JavaScript libraries such as jQuery or MooTools, commonly used by popular frameworks. To be clear, while a framework might make a "slide" animation faster to code, a plug-in provides something such as a full-fledged image-gallery, pre-built and ready for use in any application compatible

with the framework language. In terms of the web, these prefabricated functions and plug-ins combine together with mark-up and styling to create an interface between the user and the web application.

The field of rhetoric and professional communication has been increasingly interested in how interfaces mediate our retrieval and use of information (Johnson-Eilola, 2003) situate users within the power relations of technology use (Selfe & Selfe, 1994), and shape arguments about our own identities (Arola, 2010). At the base of these many inquiries is the understanding that an interface is an argument made up of visual claims, functional affordances, and appeals to a user's values and sense of universal truths. And if we are to continue to situate interface design and technical communication in the rhetorical tradition, we will benefit from drawing on all ancient practices of argument construction and invention. In terms of web development frameworks that draw on abstracted or pre-built collections of code, this paper will argue for resurrecting the concepts of the topoi and commonplaces to move toward a rhetorically-based heuristic that allows developers, specifically novice developers, to gauge the propriety and value of the arguments available on the web and within the development frameworks themselves, thus being better able to make context-specific arguments without overusing common rhetorical appeals within the interface.

The topoi and the commonplaces

If we are to consider the interface as a collection of visual and functional arguments, it seems appropriate that rhetorical theory could have many analogues or "cognates" (Kostelnick & Roberts, 2010) to ancient concepts of argumentation, style, and delivery. Two concepts, the topoi and the commonplace, share a similar purpose with the function of development frameworks and code libraries.

For Aristotle, Quintilian, and Cicero, the topoi (or topics), were the functional building blocks used in the invention of an argument. In other words, they were heuristics that provided an argument with clarifying frames such as who, why, to what degree, by what definition, etc. For Cicero, specifically, the topics did not function

as full arguments, but merely as means to an end. As Michael Leff (1996) has written, Cicero believed the topics "offer material - timbers or planks … that may prove useful in constructing an argument and which, when combined with other resources, contribute to appropriate management of a case" (p. 447). In many arguments, these "other resources" were "commonplaces."

The commonplaces were stock epithets, figures of speech, proverbs, quotations, praises or censures of people and things, and brief treatises on virtues and vices, all well known or respected turns of phrase or position statements that were commonly understood to find universal acceptance with audiences. Practiced during early schooling, the commonplaces served as a bank of prefabricated arguments that could be called upon to add "amplification" to an argument. Of course, this amplification was entirely dependent on the context of use and the skill in which the rhetor was able to deploy the commonplace within the arrangement of the spoken composition. As Leff explains, arguments discovered and constructed by use of the topoi and commonplaces "must arise through knowledge of the case at hand, and a decision about whether and how they are used cannot be specified by topical method, per se, but must depend upon situated judgment" (p. 488).

Quintilian (1856/2006) stresses the importance of situated deployment of the commonplaces, suggesting that they are much like "weapons which we should always have stored in our armoury ready for immediate use as the occasion demands" (II.i.12). It is a practice of poor argumentation to memorize a commonplace and insert it carelessly into the argument without paying any attention to the context of the argument or the audience at hand. Quintilian argues that while the commonplace, however beautiful, can be called upon and deployed at any moment, it should be "ready," not "wanted," for careless use is almost always "superfluous and sometimes even noxious" (II.iv.32). Essentially, the use of common arguments must be reserved and shaped for specific rhetorical situations as to avoid diluted power and cliché.

Much like ancient rhetoricians, contemporary writers, web developers, and programmers have similar banks of arguments available for deployment. However, instead of building these commonplaces into verbal arguments, development frameworks

allow developers to build plug-ins and widgets into interfaces, sometimes quite easily. And for novice developers, it is this ease of usability that can limit the developer's ability to exercise agency and sound judgment in the development of an interface.

Usability, agency, and techne

As usability studies has transitioned from user-friendly design, to user-centered design, to user experience design, the streamlined "ease" of product use and interface use has been a central concern (Krug, 2005; Norman, 1990). This ceding of problem solving abilities and judgment to our interfaces is the subject of Bradley Dilger's (2007) critique of consumerist values of "ease" and simplicity driving current work in usability studies, a trend he calls "extreme usability."

Dilger argues that while usability evangelists such as Jakob Nielsen and Don Norman promote multi-faceted definitions of usability, much of their message focuses on the ease of products and their ability to make consumers' lives easier and avoid the extraneous work of figuring technology out for themselves. Steve Krug (2005) has gone so far as to make this consumerist demand central to his best selling usability manifesto, which he titled *Don't Make Me Think*. Dilger suggests that this version of usability, in extending the ideological framework of "ease" and consumerist values of speed and convenience, encourages an "out-of-pocket rejection of difficulty and complexity," and that it "displaces agency and control to external experts, and represses critique and critical use of technology in the name of productivity and efficiency" (p. 52). The result for the novice user, is that the "frictionless and transparent nature of extreme usability becomes self-perpetuating; because novice users develop only instrumental knowledge of a system…their need for extreme usability - and their need for the system to know their "needs" - can be perpetual" (p. 56). By perpetuating the novice/expert binary and relying on products and systems which disconnect the novice from the cultural and historical contexts of their technologies, "extreme usability" essentially black boxes the expertise and the reasons for why technologies were invented, built, and deployed.

Robert Johnson has also interrogated our cultural understanding of "use" and technology, juxtaposing these modern terms with the ancient concept of *techne.* The ancients described techne as the skill or knowledge on which an artist or craftsperson relied to shape raw materials into useful objects, discursive or material. However, Johnson reminds us that techne was not only associated the production of an object, but was also concerned with knowledge of an object's use and "thus was indelibly imbued with concepts of human action (phronesis/praxis) and ethics" (p. 344, Johnson, 2010). Johnson suggests that if our approach to technology replaces the "meditative" practice of techne, with its attention to problems of use and societal implications, and becomes inverted with the modern "calculative" approach to technology, thoughtless, task-focused, and ephemeral in its scope, the makers of technologies may become "untethered from the social fabric and, as a result, out of touch with the humans who use those technologies" (p. 349).

While Dilger's critique of extreme usability might be primarily focused on physical products and GUI interfaces, and Johnson's argument concerned with technological praxis between producer and user, their arguments regarding user agency and a general "deskilled," short-sighted approach to technology are salient to the discussion of development framework usability and its effect on the social and practical success of development teams. As Jakob Nielsen (1993) reminds us, even an alpha-numeric command line is a kind of interface with a producer on one end, and often another user/producer on the other.

Use and the developer community

All developers, regardless of expertise, reuse code. A central tenet of programming states that "no problem should ever be solved twice" [19]. Reuse of common functions and structures is a survival skill one must learn in order to meet the demand for efficiency and expedited work, which is a primary reason for the creation of development frameworks. However, when novice developers scour the web for frameworks and plug-ins to enhance the aesthetics of a page, they may be trying to answer problems different from those of the developer who originally built these scripts and systems. The open source communities that share these plug-ins attempt to show transparency in their work by providing a wealth of tutorials that

demonstrate the plug-ins and also display and explain the code. Unfortunately, a tendency exists within the novice community to grab code, paste it into applications, and ignore the implications of plug-ins built for specific purposes.

In his 2011 *TechCrunch* article titled, "Why the New Guy Can't Code," software developer Jon Evans, describes the agony that thoughtless, patchwork plugin deployment can cause for development teams: "We've all lived the nightmare. A new developer shows up at work, and you try to be welcoming, but he can't seem to get up to speed; the questions he asks reveal basic ignorance; and his work, when it finally emerges, is so kludgey that it ultimately must be rewritten from scratch by more competent people" (Evans, 2011). Evans is not alone in his description of less-than-competent developers infiltrating development teams. In the case of jQuery, the popular JavaScript library, many techie forums and programmer blogs have castigated "noobs" or novice users for perpetuating the use of the JavaScript language through jQuery without necessarily knowing how to use it, without knowing how to use it well (writing bad code), and without knowing the specific developer culture from which it has grown.

And though many of these posts or forum titles may hint at an elitism within programmer culture, these concerns are revealing the existence of a growing population of web writers whose calculative approach to production places the value of the work in product-focused rather than use-oriented development. In Johnson's terms, this inversion of ephemeral product-oriented thinking over craft knowledge "untethers" the technology from not only the user/developer and the social fabric of development team, but also risks alienating the end user for whom the plugin or the presentation aesthetic was never intended. This change in developer culture provides impetus for a focus on rhetorical foundations of framework reliance, code-reuse, and analysis of plugin propriety for specific contexts of use.

Analysis of a framework: Twitter bootstrap

To elucidate the concerns central to the use and misuse of front-end development frameworks, this section will examine one of the most popular front-end frameworks in use at present, Twitter Bootstrap.

Originally developed by Mark Otto and Jacob Thornton as a collection of libraries to aid the development of user interfaces for internal data management applications at Twitter, Twitter Bootstrap was released as open-source in 2011 and is at the time of this writing the most watched project on GitHub, the collaborative versioning and revision control network for software and web development projects. Bootstrap provides a powerful HTML, CSS, and jQuery-based framework for the rapid development of "cross-everything" compatible web pages/applications that retain their integrity on desktop monitors, tablets, and mobile device. The framework provides a simple CSS class-based initialization for many of the plugins, such as dialog boxes, carousels, and dropdown menus, allowing developers to introduce components to their web pages with single word class declarations in their HTML. Additionally, since Bootstrap 2.0, the framework defaults to a responsive layout, allowing the display of the page to render differently depending upon the device being used.

While such features are a boon for developers building cross-compatible applications that rely heavily on common JavaScript functions, Twitter Bootstrap has attracted criticism from the expert developer community for its often replicated stock layouts available with a default loading of the framework. Others have raised concern about Bootstrap's bloated JavaScript collection, which, novice developers may leave "unpared," sometimes causing unintended conflicts with external scripts. In his recent article, "Great, Another Bootstrap Website," Paul Scrivens (2012), web designer and social media expert at North Social, describes a worrisome trend in the design of web-based information where using development tools are becoming synonymous with programming knowhow. Describing both Bootstrap and the popular Ruby framework Ruby on Rails, Scrivens writes, "This is the danger behind frameworks. Ruby on Rails is great for a lot of people, but there are some who learn how to program from it and in the end don't really learn how to program at all. If you are a designer and you are using Bootstrap as your learning tool then you might be in for a rude awakening when you finally have to venture out on your own and create a custom design." Scrivens cites Bootstrap's showcase gallery of sites using Bootstrap, and laments the glaring similarities between them, arguing that front-

end frameworks should exclusively be used as a code base for developers, not an aesthetic silver bullet. However, developers such as Reuven M. Lerner (2012), see that for a programmer "who is design-challenged, the introduction of design frameworks has made it possible… to make a Web application that doesn't cause people to go screaming into the night."

Both Scrivens and Lerner bring their disciplinary biases to their arguments, the designer tired of visual clichés, and the developer relying on those clichés for "good design." While this dichotomy represents the common concerns about Bootstrap between designers and developers, we should be complicating this question further if we are to vet and use front-end frameworks responsibly. Does Twitter Bootstrap, or similar front-end development frameworks represent what our fields describe as effective communication? Does an unquestioning allegiance to a framework's default code set, structure, and aesthetic ever achieve this goal? The answer to these questions should be a resounding "Maybe" if we are to understand our work as a rhetorical and context-based enterprise. However, in order to have full control over our communication, we must help novice developers master the tools, their languages, and their topical and aesthetic landscapes in which they exist in order for their communication to be products of "situated judgment."

Conclusion(s)

As our UX-related fields continue arguing for information designers to shape interface design and write code, we must include in these discussions questions of agency, expertise, and argumentative best practice. Borrowing from Cicero and Quintilian's discussions of the topoi and the commonplaces and problematizing the usability of frameworks through the lens of extreme usability, we might find rules of thumb and assertions to follow as we design and build.

Primarily, we must reiterate that what we design are interfaces and that interfaces mediate information dispersal and communicate arguments. The building blocks of those arguments will only be as effective as the skill with which a developer deploys programmed

functions and prefabricated plug-ins and the level of awareness she has for the micro and macro contexts where the interface will be used. If, as Quintilian suggests, our commonplace arguments—in this case, plug-ins—exist as weapons available for use at the appropriate time, we must be aware of user needs and user goals before we deploy plug-ins for interactivity's sake. Overuse of common tropes or figures will dilute our arguments and run the risk of cliché, and eventually diminished use of our applications and websites.

Additionally, we must acknowledge the imbalance of power we accept if we are to build with highly usable frameworks and also question the intentions of communities that provide frameworks that function at such a high level of abstraction that manipulating at the source is reserved only for expert builders. At a pragmatic level, relying on the expertise of framework developers limits our options as designers and developers to whatever currently exists. Such an approach to design cripples the invention process and, continuing Quintilian's battle metaphor, forces us to work with the army we have, rather than the one we need.

Finally, if we are going to take building seriously, we need to be thinking about source code as an interface as well. Some in the Digital Humanities and Critical Code Studies communities are doing just this. However, as information designers, we have an immense amount of experience with audience analysis, text design, and document usability to inform the interrogation and development of best practices for web designers.

Ease will surely remain an illegitimate rhetorical justification for how to compose and design situated communication for as long as our associated disciplines exist. As such, ease is also rarely justifiable in user-centered development, because ease in the development process is enjoyed solely by the developer - as well as the institution, organization, or developer community controlling the overall design of that communication.

Developing new practices that move away from usable code experiences may be uncomfortable for developers. Though, if we can avoid the seamless user experiences made possible by development frameworks and APIs, we can break the

novice/expert binary, reclaiming agency and building applications better fit to user needs and specific contexts of use.

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I See You're talking #HPV": Communication Patterns in the #HPV Stream on Twitter

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This poster reports data from a pilot study of communication practices in the microblogging site Twitter. A content analysis was conducted on a random sample of 50 tweets from the #hpv (human papillomavirus) stream in order to determine any recurring practices such as use of links, retweets, uses of the @ symbol, and other phenomena. The pilot study found that, unlike studies conducted on communication patterns in Twitter streams, the participants in the #hpv stream use it to primarily broadcast information as opposed to interacting and conversing with one another, and collaboration, while present indirectly, is minimal. The researcher plans to expand the sample set to 900 tweets and continue the process of content analysis in order to determine more solid findings for practices of communication in this space. The researcher also plans to examine other spaces relevant to the exchange of information on HPV, conduct content analyses for them, and compare them to the findings on Twitter. The goal is to use these findings for both health and technical communication so that better systems can be designed to optimize the power of participant generated information spaces.