

# Experiential Media and Digital Culture

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**Multidisciplinary value structures and a design approach focusing on combining efficiency, reflection, and quality of experience will foster the true hybrid physical-digital culture that is foundational to solving complex societal problems.**

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**T**he global problems that impact today's densely interconnected society present stark resource, energy, and sustainability challenges. Rather than being singular component problems, as in the need for better data analysis, these complex issues are primarily cultural, as in the need to develop a sustainability culture. As such, understanding and tackling them requires exploring culture as an integration of knowledge and values arising from the diverse experiences of its constituents.

From this perspective, utilitarian, social and communication, structured learning, and contemplative experiences contribute to developing an integrative body of knowledge and values. For example, the contemplative experience of reading a metaphorical passage can help the reader re-think everyday moments, while the structured compilation of carefully observed experiences can give rise to broadly applicable metaphors.

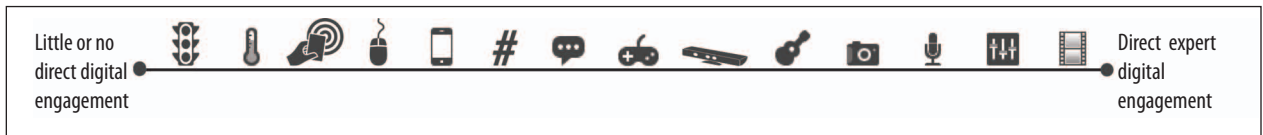
Many experiences now involve digital media. Experiential media—the integration of computational media in everyday experiences—is apparent in the utilitarian (traffic networks), social (participatory media), learning

(online courses, games), and contemplative (filmmaking) domains. Experiential mediation is evolving quickly and increasing the amount of discrete hybrid physical-digital knowledge. However, few existing integration structures can merge these instances into a coherent system of reflective knowledge and values that is foundational to a truly hybrid physical-digital culture. In turn, the lack of such a mature culture is hindering the development of integrative cultural solutions to complex, societal problems.

We propose the emergence of a truly integrative hybrid physical-digital culture, which will require the broad integration of knowledge across engineering, arts, design, humanities, and the social sciences. It will also demand a value system and related design approaches that emphasize the integration of efficiency, contemplation, and quality of experience. Society can then advance a generation of experiential media systems in which utilitarian applications engage an activity's meaning—not just the activity itself—and in which contemplative forms are metaphors of the emergent complexity of the everyday, communication and social applications promote reflective transactions, and learning systems motivate through experiential quality.

## HYBRID KNOWLEDGE

Earlier cultural epochs typically included a small privileged class of individuals versed in the arts and sciences and imbued with decision-making authority. At the same time, such cultures also contained rich folk traditions within the masses, with a slowly evolving overlap between the two. The Age of Reason, for example, saw the prolif-



**Figure 1. Distribution of experiential media systems. At the far left are sensor networks that require little direct engagement. At the far right is filmmaking, which requires direct expert participation. (Mouse icon design courtesy of Camila Bertoco, smartphone icon design courtesy of Stefan Bumbeck, Kinect design courtesy of Luca Erbifori from The Noun Project.)**

eration of popular texts and the emergence of amateur female musicians.

Analysts now understand these patterns as catalysts in the emergence of a flattening popular and transactional culture, with smaller outposts remaining within the folk or traditional and the trained practitioner realms. The opportunity lies in integrating these varying forms in a way that elevates their richness, depth, and cultural longevity in potentially transformative ways.

The philosophical field of phenomenology advances the case that much of human knowledge is empirical and arises from embodied, physical experience. Phenomenology contrasts this empirical approach to exclusive rationalist or Cartesian theories that approach knowledge as a purely mental representation of the world. Building on the principles of phenomenology, hermeneutics introduces the notion of interpreting experiences in relation to both personal understanding and the experiences of other cultural members. Paul Ricoeur, a leading hermeneutics' proponent, attests that nothing is simply "given" to consciousness; rather, mediation and interpretation arise through language, symbol, culture, and history.<sup>1</sup>

Within the specific context of technology, phenomenology, hermeneutics, and embodied cognition theories have significantly aided the development of successful principles for intuitive human-computer interaction and the emergence of embodied computing and experiential media—the latter being systems that integrate computing and digital media with the physical and social experience. The main goal of these hybrid media systems is to facilitate and enhance an individual's experience in a way that will lead to more integrated knowledge.

## EXPERIENTIAL MEDIA SYSTEMS

Figure 1 is a continuum of experiential media systems representing areas of activity that contribute to the generation of cultural knowledge and values. Although some examples, such as advanced gaming controllers and smartphones, are encountered mostly in postindustrial nations, other systems, such as musical instrumentation and cameras, are more widespread. Along the continuum are various degrees of purposeful engagement and experiential activity—how deliberately the system involves the user in the digital experience. Systems on the far left represent little or no direct engagement, while systems at the far right allow the user to create and shape the experience.

## Sensor networks

Traffic control systems combine sensor networks, computational analysis tools, and control feedback signals as part of a smart environment that rarely directly engages users.

The computational complexity and intelligence of these systems is growing to the point that adaptive models can now allow traffic signals to partially self-organize.<sup>2</sup> These systems learn from users while the users learn to function within the systems' constraints. Although the result benefits society by improving traffic flow, users rarely consider the computational intelligence in relation to their own travel activities. Without meaningfully engaging in key parts of the everyday hybrid physical-digital experience, users will find it difficult to productively reflect on that experience.

Digital thermostats are another example of a sensor network, but in these systems, user engagement goes up a notch. Thermostats highlight the notion that even the slightest direct engagement with an experience's digital elements can produce baseline meaningful interaction. Just the responsibility of briefly adjusting the device causes users to consider its location, how its output relates to the room temperature they experience, and how a seemingly unrelated activity, such as leaving a door open, can affect that relation. The brief involvement of thermostat setting causes reflection on all these factors.

Swiping an access card with a magnetic strip is another example of a simple sensor system interaction that can generate baseline knowledge. Most people realize that the strip contains digital information and understand that the sensor reader accesses that information based on the user card movement. During this simple interaction, the user can also reflect on issues such as digital identity, even though the sole engagement activity with the swipe system is utilitarian: to make a purchase or gain building access.

It is easy to create an intuitive experience with a simple system that addresses a narrow function like access. However, as direct engagement with digital components increases, developing solid experiential mediation and related knowledge by carefully considering demonstrated principles of experiential media design will become more important. For example, the mouse and graphic display interface took advantage of key innate human motor and spatial reasoning abilities to allow intuitive control and organization of the computing workspace and to facilitate computing access for the nonexpert.



## Smartphones

Modern smartphones and tablets have extended computing beyond the desktop and into daily living. These devices have advanced experiential mediation to the point at which users now interact with complex digital media at the level of meaning, as opposed to just carrying out an activity. For example, users navigating new territory can view a map or directions on the smartphone touchscreen and use pinching gestures to rescale the map. The computer extracts and reacts to the gesture's meaning, opening to expand and closing to compress; the action is more than a simple gesture trace.

Although reading a map on a smartphone might be construed as utilitarian because the user needs directions or location information, this interaction can also support user social and entertainment activities. Texting and social media communication (tweeting, status updates) are farther to the right on the continuum depicted in Figure 1. Together, the device and applications not only

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## Social entertainment and communication activities strongly orient around hybrid and customized content consumption.

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enhance users' understanding of their environment but also cause them to reflect on the complex mediation network of sensors, transmitters, analytical tools, and displays involved in their experience. Thus, engagement in the digital part of this experience increases, and the result is the generation of true hybrid physical-digital knowledge.

## Social activities

Social entertainment and communication activities strongly orient around hybrid and customized content consumption. Users can start and stop a Netflix movie, select a music genre on a Pandora station, and organize pictures in iPhoto. Selecting and customizing created content generates a fairly elaborate relationship with a variety of digital delivery components, and arguably, customization is the first step toward content creation.

Digital recordings are easy to edit and remix using simple, intuitive interfaces such as Gimp and Audacity. Content capture has also become much easier. Smartphones have one-click photo and videocameras, and many inexpensive but dependable interfaces enable digital recording. Indeed, the compilation of experiential media—smartphones, touchscreens, gestural interfaces, and intuitive experience recording and editing—has simplified and popularized amateur content creation. The many available avenues for publishing amateur content, such as Flickr and YouTube, incentivize casual creative

activity and content sharing and make it easier to grow the supply of user-generated content.

These opportunities to create content are changing the generated and collective knowledge within the digital community. The amateur content creator is gaining not only digital knowledge (how to touch up a picture), but also complex hybrid knowledge (how pixelation relates to light and sampling definition). This knowledge might not be born of rigorous formal training, but it is powerful enough to enrich social media and contribute to the growth of social media platforms.

Beyond being a way to share interests, stories, events, and photos, Facebook is primarily a mechanism for constructing and experiencing a digital community. In this process, participants become significantly involved with computational facets, including issues of complex computer networks, recommendation mechanisms, and connectivity.

Online gaming similarly engages participants in the digital aspects of their gaming experiences. In some of the more advanced participatory games, such as *World of Warcraft* and *Guild Wars*, players can design digital elements within the game, as well as actively create fan art outside the game. Before computing's popularization, games of all kinds encapsulated rich physical experiences with full engagement of every aspect of a player's mental and physical capacity.

In modern gaming and in social media in general, users are increasingly engaged in their experience's digital components, which is leading to an increase in hybrid knowledge. In some particular applied instances, such as mediated therapy, the amount of digital knowledge might even be overwhelming physical knowledge.

## Learning and education

Experts in mediated learning have long recognized the importance of games in furthering knowledge. Modern computer games have adaptive and participatory structures that allow for active, customizable learning along with offering sheer entertainment value. This combination is proving very effective for 21st-century learning.<sup>3</sup> Online learning systems, such as MITOpenCourseWare and Coursera, are enabling knowledge dissemination at unprecedented levels, even questioning some of the basic assumptions of knowledge-delivery financial models. The creators of these learning vehicles are deeply engaged with the systems' digital components to the extent that their experience of and concepts about learning and education have changed.

Professional content creators are also directly engaged with digital creation, and most already are or are becoming hybrid knowledge experts. Much contemporary music is created through interaction with digital tools—from acoustic sound that is mixed or sequenced through

digital means to music performed on hybrid (physical-digital) instruments, and music composed using computer algorithms and performed by computers.

Filmmaking is an equally hybrid experience, again ranging from primarily physical performance captured and post-produced through digital means, to films in which some or all of the content is realized through digital means, including 3D animation, special effects, and machinima. Finally, expert videogame creators also exhibit hybrid skills and approaches as they combine interaction design and storytelling (Shigeru Miyamoto), computation (John Carmack), real-world problems (Jane McGonigal), and complex systems (Will Wright). All these professional expert creators of original, rich experiences have deep hybrid knowledge that can prove critical to advancing the maturity of a hybrid physical-digital culture.

## EVIDENCE OF FRAGMENTED CULTURE

As the “Effects of Fragmented Culture” sidebar details, most of these examples exist in a fully or partly discrete space, as opposed to coexisting in an integrative metaspace—a fragmented state that is hampering the evolution of a truly hybrid physical-digital culture. Examples of this fragmentation are evident in experiential media systems from traffic control to the arts and social media.

### Traffic control

The engineers developing sensor networks and algorithms for analyzing and controlling traffic are now working with transportation experts, city planners, and, occasionally, public policy experts, including social scientists and economists. Conspicuously absent are the perspectives of artists, designers, and humanists, despite the long history of such viewpoints generating rich experiences motivating change in beliefs, behavior, and knowledge. Rather, developers assume that speed and efficiency or financial incentives are sufficient to motivate behavioral change. As Nobel Laureate Lee Hartwell recently remarked at the Emerge Symposium (<http://vimeo.com/tag:emerge2012asu>), the first and most important step in achieving sustainability is directly engaging people, not analyzing behavioral data on the disengaged.

### Learning systems

The idea of engagement as a key path to learning continues to drive significant advances in serious games, educational games, and mediated learning. However, many mediated learning efforts are not integrating the full range of expertise required to produce gaming designs, in which the quality of the experience is the main incentive for engagement. Instead, they at-

## Effects of Fragmented Culture

**W**ebster’s defines one understanding of *culture* as “the characteristic features of everyday existence (as diversions or a way of life) shared by people in a place or time” ([www.merriam-webster.com](http://www.merriam-webster.com)). It also offers an alternative definition, “the integrated pattern of human knowledge, belief, and behavior that depends upon the capacity for learning and transmitting knowledge to succeeding generations.”

By the first definition, a hybrid physical-digital culture already exists, and indeed many characteristic features in everyday experience are hybrid and produce various levels and types of hybrid knowledge. However, the second definition speaks to an integrative body of deep knowledge, in which society builds beliefs and reflective behaviors. In that sense, current hybrid experiences are overly fragmented and thus cannot yet produce the deep transferable knowledge and values associated with culture. Underlying that fragmentation is the communicative distance between the people and communities who develop and study experiential media.

Earlier work<sup>1,2</sup> argued that the creation of meaningful mediated experiences requires the integration of knowledge from the arts, design, engineering, science, and humanities. Although connectivity among these areas is increasing, integrative discourse and activity is still not widespread. The most significant fragmentation occurs between the quantitative constituents of experiential media development (engineering and science) and the qualitative components (arts, design, and humanities). Merging the different approaches and priorities of these contributing communities is difficult.

Fragmentation among system developers leads to biases in design that affect subsequent usage patterns of experiential media and diminish the value of the resulting knowledge. In the 1930s, John Dewey decried the “hurried and impatient human environment ... where what is called experience becomes so dispersed and miscellaneous as hardly to deserve the name.”<sup>2</sup> Similarly, Phoebe Sengers argues that much experiential technology development is based on optimization (Taylorism) models, with the main goal being to do more and do it faster. The result is a culture with optimization as the leading value; people consistently try to do more until they exhaust themselves and seek refuge in mindless entertainment.<sup>3</sup> Digital technology clearly has a role in the misunderstanding of the relationship between doing and undergoing.

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tempt to incentivize engagement through the need to win (gain points), to discover what happens next, or even just to enjoy the novel digital gadgets.

Developers are missing the idea that people play games to have a rich and rewarding experience. Many of the most



intriguing and fun games, such as hide and seek, embody the physical, involve others, and promote continuous discovery, such as finding the best places to hide and anticipating where the searcher will go next. Similarly, people play music primarily for the quality of the experience and personal creative discovery, not to win points or find out what happens next or because they want to experience a new gadget. Most people play music they have played before, and they are deeply attached to their familiar and comfortable instruments.

Rehabilitation is another learning domain that suffers from a lack of rich experiences. Therapists rely on off-the-shelf computer games and culturally uninformed incentives to rehabilitate adults who yearn for high-quality

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experiences. Adults whose quality of life has suffered because of a health condition are not interested in beating a random computer character and can find the recommendation to play these games patronizing. Fortunately, alternative designs of interactive rehabilitation systems are beginning to use more meaningful feedback structures.<sup>4</sup>

### **Arts and entertainment**

Increasing embodiment in experiential media is also constrained by fragmented development expertise. An example is *Dance Central*, the first popular dance game created for the Kinect interface. The game, which requires that all players face the screen, relies on traditional computer vision and computer graphics perspectives as it mimics players' movements. However, most dancing is not simply mimicking but rather an interaction in which dancers imitate and improvise. It is about moment-to-moment interaction but it also involves interaction that draws on space, time, body relation patterns, and a fine balance of repetition and variation. Advanced dance and choreography knowledge could have provided insight to create a more realistic, engaging, and culturally aware game.

Music performance embodies centuries of knowledge about how to achieve mastery of performance involving complex interfaces and how to tackle motor control issues related to that objective. However, little of this knowledge has found its way into labs that develop embodied computing interfaces and control and movement-assistance systems. Theme park creators know that humans use all their senses to explore novel, complex environments, and they leverage that idea by using audition to monitor complex time patterns, vision for spatial relations, and touch for detail investigation and intimacy. However, complex

data navigation remains primarily a two-dimensional visualization-based activity.

### **Social media**

Social media platforms aim to increase the size of target communities and the number of transactional exchanges within them (consequently generating advertising revenue). This goal seems to largely preclude paths for generating the deep contemplation and high-level creative activity that produce and sustain a mature culture. Many important cultural eras, notably Athenian democracy, the Renaissance, the Age of Reason, and Modernism, formed through rich social interactions that advanced the scientific, social, learning, and creative aspects of cultural development in an integrated manner. Although much earlier dialog was constrained to the middle and upper classes, modern society can move beyond this privileged cultural separation by using digital media to engage a broader mass audience. The "Evolving the Artistic Perspective" sidebar describes the role of the design and arts communities in exploiting this opportunity.

### **TOWARD A DIGITAL CULTURE**

Although we have highlighted some unfortunate trends, there is also reason to be optimistic given the number of ongoing efforts to promote the integrative development of experiential media systems. For example, many design and art schools now require undergraduates to be proficient in programming by their sophomore year. Computer science programs are also promoting minors that connect computing to the humanities and arts. Digital media undergraduate and graduate programs combining arts and engineering faculty are rapidly growing at Arizona State University (ASU), the University of Southern California, and the University of California at Santa Barbara, among others.

### **Media-centric curricula**

Schools that recognize the importance of hybrid physical-digital media are combining arts and engineering faculty and generating innovative curricula that are media- rather than discipline-centric. ASU has developed an undergraduate degree in digital culture (<https://digitalculture.asu.edu>) that combines 50 courses from 12 academic units spanning engineering, design, arts, and social and cognitive sciences. These courses form a network connected via a set of 20 proficiencies, which are metalevel learning outcomes. Students gain a proficiency by taking courses from a range of disciplines through different paths, such as obtaining a modeling and inference proficiency through computer science, industrial design, digital music, or anthropology courses. Thus, a digital music major might take computer science or vice versa.

The ASU curricula and similar programs strike a balance between media-centric outcomes that are discipline

agnostic and disciplinary expertise that can bring many years of cultural practice knowledge to the mix. As such, they pose a model for 21st-century liberal education, in which students aim for balanced knowledge across myriad dimensions of the human experience and can choose their own path to achieve that knowledge.

We have informally observed this model in action and have seen it produce student agency and innovation, such as students designing capstone projects aimed at the potential future job they wish to create—rather than simply accept—within an existing company. More formal studies are needed to determine how such communities can advance the integrative development of mediated experiences and culture.

### Integrative industrial communities

Industry is also promoting integrative communities for the development of experiential media. Apple has long viewed the overall experience provided by its products to be the driving outcome rather than any one individual component of that experience. Intel has created an interaction and experience research group that combines engineering, computing, cognitive and social science, and arts and design expertise. Architecture and design companies such as Diller Scofidio + Renfro (architecture, visual arts, and performing arts), and Hoberman Associates (art, architecture, and engineering) specialize in developing integrative approaches for transforming the built environment. Their diverse workforce produces a broad range of outcomes—from video art to complete buildings and transformable building facades.

Industrial design firms, such as Herman Miller, are also driving innovation in product, service, and commercial development, where social change and sustainability are core company values. Frogdesign describes its company as creating “connected experiences that span multiple technologies, platforms, and media” ([www.frogdesign.com](http://www.frogdesign.com)).

These exemplary industrial leaders epitomize the clear value of cultivating diverse teams of experts and integrators collaborating on complex problems that they can only solve by working respectfully in close tandem.

### Integrative projects

A growing collection of individual projects is also exploring integrative approaches to experiential media and digital culture. We are deeply familiar with the projects we

## Evolving the Artistic Perspective

Experiential media is prevalent in postindustrial nations, but ensuring its continued maturity requires design and arts expertise. This prevalence and need for artistic expertise offer the opportunity to structure a modern culture that emulates older, more balanced models in which arts and humanist perspectives influenced everyday experience and in turn elevated its quality.

However, directly involving artists in experiential media systems design and development will require a significant change of perspective within the professional arts communities. In this new perspective,

- deterministic creation models make space for probabilistic approaches;
- paradigms of singular creators who develop finished products make space for participatory models with evolving forms; and
- practices that aim for concrete block experiences, as in presenting a complete musical composition in one location at one time, make space for experiences in which smaller instances of related sound and music aggregate to create one sonic experience (occurring in different ways and at different times).

Most important, arts practice must consider what David Wessel calls “the emerging large amateur base” (<http://cnmat.berkeley.edu>). Wessel proposes that mediated creative practice tools and processes must have a low entry barrier, thus attracting a large amateur base, but an unlimited ceiling, thus encouraging continuous aspiration.

This proposition is similar to the idea of playing the piano. A five-year-old child can play a simple tune on the piano after a week of practice, but the ceiling for playing the piano or composing piano music is unlimited. Likewise, a five-year-old child can use social media with very little practice, but the potential for endless creative enrichment and transformation is more constrained.

Providing avenues for social media tools and processes to support the generation and refinement of advanced cultural knowledge would infuse users with cultural aspirations and lead to the development of expert creative practitioners who could contribute to the growth and value of a large community.

describe here, which span disruptive arts, aesthetics in the classroom, performance practice, mediated rehabilitation, and experience capture.

**Disruptive arts.** Disrupting our everyday experience is the goal of interventionists, who provide surprising mechanisms and tools for raising awareness and inviting action. The arts community has long used unexpected reversal to generate contemplation and reflection; an example is Aristotle’s *Poetics*. Current works explore the idea of reverse surveillance and self-surveillance. Neal White’s *Dark Places* (2009) is a field guide to secret intelligence space in the UK. David Rokeby’s *Guardian Angel* (2001) challenges notions of benevolent control as part of the surveillance apparatus. Camille Utterback’s *Abundance* (2007) uses public plaza movement as the driver for architectural projection. All these works tackle the notion of the watcher and the watched from a variety of critical perspectives.

Injecting pleasure, benevolence, playfulness, and confrontation into social interactions with everyday surveillance technologies produces project outcomes that



move beyond the technology used, the data generated, or the fixed art product created. Rather, the outcome is a complex, contemplative, interactive process.

These examples highlight a key concept of 21st-century creative practice: the contemplative outcome—the direct reflective participatory process—is the overt focus rather than the actual product or installation.

**Classroom aesthetics.** David Tinapple and Loren Olson at ASU's School of Arts, Media and Engineering are rethinking the mediated learning paradigm as the practice of creative aesthetics. They are helping middle school students in the Herberger Academy create products of high aesthetic value using advanced digital processes, including algorithmic programming, 3D modeling and printing, image aggregation, and motion rendering. The overt focus is on creating aesthetically rich artifacts, but to reach that goal, students need to master complex science, technology, engineering, and mathematics (STEM) concepts. The engagement is very high from inception; students indirectly learn STEM concepts, but the learning environment remains focused on the quality of the experience.

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### Primary participation in physical experiences offers many ways to ignite contemplation and increase the appreciation of life's deeper meaning.

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Tinapple and Olson's process shows the value of a cultural model in which STEM is a means for having a contemplative rich experience rather than an end in itself. This model avoids the awkward practice of masquerading a learning exercise as a game and using points or badges as an incentive to complete it.

**Performance practice.** At Carnegie Mellon University, Roger Dannenberg has also turned a traditional gaming paradigm on its head. Instead of converting creative practice outcomes into an entertainment game, as in *Guitar Hero*, he has developed a signal recognition algorithm that follows actual guitar players, and tutors them on their errors via the Rock Prodigy app. Popular reviews and the commercial success of Dannenberg's app indicate that users are willing to pay more to experience increasing levels of creative challenge. This finding also supports the idea of using an unlimited creative ceiling as an incentive rather than winning points.

**Mediated rehabilitation.** Stroke is the leading cause of serious, long-term disability in the US. The World Health Organization describes disability as an experience that is influenced by

- the health condition's underlying pathophysiology (the stroke),

- impairments at the bodily function and structural level (muscle activity patterns),
- disability at the activity level (task performance),
- handicaps at the participation level (life and self-care involvement), and
- various personal and environmental factors.

Given that inclusive definition, effective stroke rehabilitation must address physiological constraints, motivation for participation, trust, information communication, the therapy's adaptability, and the long-term sustainability of therapy and outcomes. Consequently, experience design must integrate optimization with reflection and quality of experience within a broader awareness of cultural context.

Over the past six years, we have worked collaboratively with experts from engineering, computing, design, arts, medicine, and neuroscience in developing a mixed-reality system that can aid the rehabilitation of a stroke survivor's upper extremities.

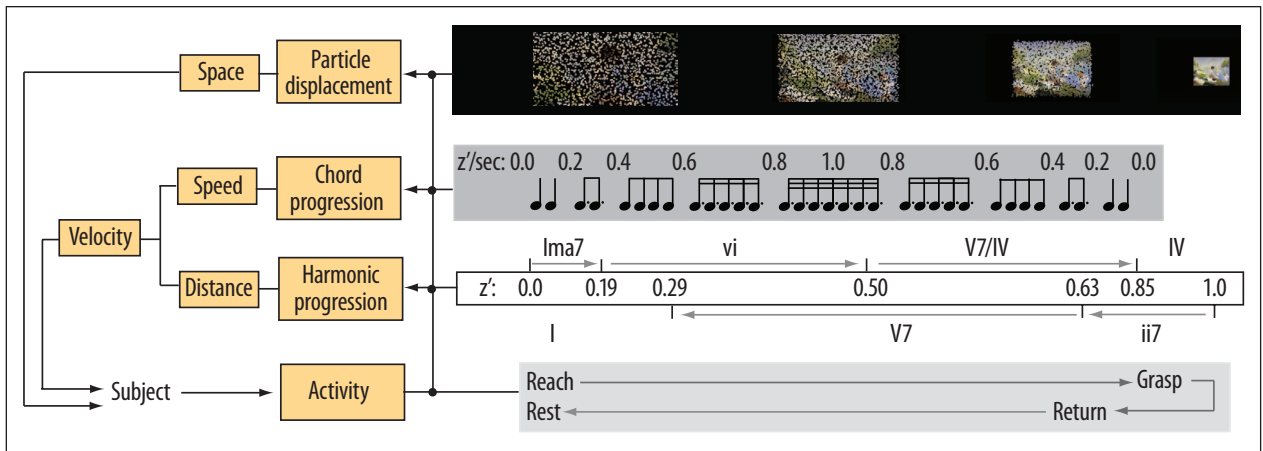
Figure 2 shows a diagram of how image size coupled with harmonic progression indicates progress to a target. The system tracks key components of movement and provides multimodal digital feedback to help users execute and plan their movements. A recent study shows that the system can enhance physical rehabilitation by advancing movement quality to aid in functional recovery.<sup>5</sup>

**Experience capture.** These examples point to a growing body of work and support structures for developing hybrid experiential systems that fall on the right side of the continuum in Figure 1. The development of such systems returns value not only from the final product, but also—and more essentially—from the development process itself and the issues being considered. This idea of deriving value from considering the process of developing hybrid experiential systems is at the heart of our recent project to capture and summarize event experiences. Our ultimate goal is to provide insights into how a hybrid culture emerges.

For the three-day Emerge symposium held at ASU in March 2012, we developed a multimodal documentation framework for capturing and representing the event experience (<http://emerge.asu.edu>) and presented findings from this work as part of a four-month interactive exhibition. The captured and assembled data will be available online in late January 2013.

We also aim to disseminate exemplar, current, and in-progress work integrating science, engineering, art, and design through our virtual eXchange for Science, Engineering, Arts and Design (XSEAD) portal (<http://xsead.org>), which is sponsored by the National Science Foundation.

Our goal is to reach diverse audiences, such as expert practitioners, emerging researchers, parents and stu-



**Figure 2.** Mixed-reality rehabilitation system. Image size couples with harmonic progression to indicate the user's progress to a target. The system uses arts principles to develop optimal displays of high aesthetic value and to generate creative paradigms such as metaphoric mappings and participatory narrative development to engage and motivate the user.

dents, and the general public with a rich variety of performance animation code, video, and prototypical artifacts. These works can stem from distinct sources including workshops, cultural probes, site-specific work, open source frameworks, and participatory design.

We anticipate that the XSEAD portal will highlight hybrid collaboration and the active process of engagement as paramount in crafting experiential systems of societal and cultural value.

### Funding support

Creating and sustaining a truly hybrid digital culture requires funding and support from agencies and foundations willing to invest in transdisciplinary projects that produce diverse outcomes. The NSF's former CreativeIT program supported transformative projects spanning creativity, computer science, and information technology. The Andrew W. Mellon Foundation has been instrumental in supporting several initiatives, including establishing the Center for Art, Science, and Technology at the Massachusetts Institute of Technology and providing generous support to the ArtsEngine at the University of Michigan.

The MacArthur Foundation and the Bill and Melinda Gates Foundation recently awarded Electronic Arts more than \$10 million to create the Games, Learning and Assessment Lab (GlassLab) to develop next-generation educational games and assess game-related learning outcomes. Corporations and private donors are also exhibiting interest in supporting art-science integrative work. The Frank-Ratchye Studio for Creative Inquiry at CMU recently received a \$1 million naming endowment to establish the Fund for Art and the Frontier, while one of the new Intel-funded centers at Georgia Tech is directed toward humanities-driven social computing research.

**T**he aggregate experience that experiential media produces needs to integrate optimization with contemplative value and quality of experience in terms of both sensory engagement and depth of meaning. For example, readers return to a Shakespearean play again and again because it communicates its meaning effectively (even optimally), uses beautiful language (engaging in form), and promotes contemplation of individual and societal topics. Each rereading of one of these plays offers an opportunity to extract new meaning. In contrast, systems and experiences that do not integrate deep meaning structures try to attract attention and sustain engagement through surface ornamentation.

Many social media practices reinforce this point, focusing on continuous redesign or the addition of features to maintain attention. In contrast, primary participation in physical experiences offers many ways to ignite contemplation and increase the appreciation of life's deeper meaning. As evidence, consider how a short walk can provide diversions that induce deep contemplation and meaningful discovery.

As experiential media systems evolve and encapsulate a large part of daily life, promoting development approaches that integrate diverse expertise is crucial. This will result in architectures that address optimization within the bigger context of quality of experience and meaningful knowledge and ultimately will support a more harmonious culture and society. **□**

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