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Humans interpret the world through multiple lenses, determined by both culture and environment, which form the basis for human bias and deeply influence how people interpret their relationships and sense of self. The nature of these lenses and how reality is experienced has dramatically evolved with the introduction of digital technologies and easy access to information via the web. Our perspectives are profoundly influenced not only by the cultural values of a global population, but by the underlying tracking technologies fueling the economic underpinnings of the web.

The growing prevalence of augmented and virtual environments is set to extend our collective human cognizance. Our sense of physical identity, time, and agency will become subject to entirely new paradigms, where the gateways to these experiences might be controlled by interests other than that of ordinary citizens. The autonomous and intelligent systems (A/IS) backbone enabling real-time personalization of any end-users' Extended Reality (XR) world raises a host of ethical and philosophical questions about the collection, control, and exploitation of user data within these ecosystems. As these capabilities move from external headsets into much more subtle, integrated sensory enhancements (and embedded or implanted devices) the stakes can become perilous.

This chapter develops methodologies that provide an ethical framework for XR systems in order to assure that the rights of the individual are reflected in the foundation and encoding of the rapidly evolving landscape of these technologies. Rights should include control over one's agency and one's (increasingly) multifaceted identities.

In order to avoid negative consequences in XR systems enhanced by A/IS, society must proactively seek solutions, set standards, and adopt methods that can enhance access, innovation, and governance to ensure human wellbeing. By adopting a lens of pragmatic introspection, society can envision a positive outcome for all the inspiring and immersive realities humanity will encounter in the near future.

This chapter addresses the challenges as follows:

1. Social Interactions
2. Mental Health
3. Education and Training
4. The Arts
5. Privacy, Access, and Control

Section 1—Social Interactions

The nature of XR and the ability for individuals to alter their identity (or for their identity to be altered by other actors) means that social interactions would likely be deeply affected by the widespread adoption of these technologies, especially as influenced by A/IS. For example, XR (AR/VR) technologies are very popular in China, where dedicated experimental zones are gaining significant traction in sectors such as retail and law enforcement; and Virtual Reality (VR) cafes are changing the way we interact with people around us and offer experiences that rival movie theaters, theme parks, and travel. VR applications are used to provide an interactive experience for tourists who can better acquaint themselves with new environments and attractions; for example, London Natural History Museum's app, 'Hold the world,' allows users to move and manipulate objects that are not available to the general public.

XR also changes the way we experience our physical reality on a daily basis. This may come in the form of virtually placing furniture in your room before buying, or trying on a new pair of glasses at home.

In addition, XR enhancement over the next generation may become ubiquitous in the physical environment, from our homes via immersive entertainment to city streets and shops, and that would alter our view of what constitutes reality. In this regard, it is critical to promote widespread education about how the nature of XR may affect our social interactions, including avoiding widespread negative societal consequences, as well as education that addresses the use of extended reality.

Issue: It may be difficult to recreate the spontaneity of traditional reality without eradicating the positive effects of serendipity within the realm of XR A/IS.

Background

For several years now, we have witnessed how online systems automatically sculpt the reality we encounter. There are two major forces at play here: the commercial imperative to give customers what makes the company money, and the desire of customers to use technology to make their lives easier, more comfortable, more controllable, safer, and less disruptive. From the last decade of computational and interactive media has emerged a rudimentary version of what the coming intelligent XR world may look like. The use of personal data and A/IS are creating an environment in which the user has become the product.

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Eli Pariser's "filter bubble," which describes how online personalization can reduce one's exposure to opposing ideas and opinions, is the inevitable result of consumers' desire to get what they want to be enabled by industries that naturally want to create products that will sell. This effect will become qualitatively different and much more profound when the curated content goes from a window on a laptop to a seamless part of the physical world. And this marketing tactic is beginning to be put in use. In 2016, Mondelez released an XR advertisement for several new Oreo flavors. The advertisement had almost 3 million viewers placed inside a world created for the purpose of advertisement.

Is an augmented or virtual world an improvement over the physical world when it can be controlled in ways possible only in a virtual space? Or does it become a denatured place, a software concoction more inclined toward order and predictability than freedom and invention? What effect would widespread use of such technology have on individuals, society, and politics over the long term?

In a physical village or city, a great deal of life, good and bad, is open to randomness, chance, risk, and the constant threat of encountering behavior one would rather not encounter. At the same time, there are unpredictable and often inspirational experiences that broaden one's exposure to human diversity. In a gated suburb, by contrast, these qualities are markedly reduced. We trade inspiration for safety. Qualities are traded off for other qualities.

Creating the digital version of the gated community will happen naturally—they are both designed systems. But how can developers create A/IS-enabled immersive experiences that allow users what might be called the "random city option"—the ability to live in, for example, a virtual world that somehow mimics the truly unpredictable aspects many people love about cities? Can such a simulation have the same effect as the "real thing" if there's no actual risk of serious unpleasantness? Could the degree of "serendipity" be dialed in by the user?

In the real world, bumping into a stranger when your GPS breaks may mean you meet your life partner. However, in the digital and virtual spheres, algorithms that have been programmed by design may eliminate genuine randomness from our human experience. What do we stand to lose when we code "frictions" or randomness out of our lives that may cause discomfort, but can also bring joy and growth? Should such randomness be added into programming?

Recommendation

Upon entering any virtual realm, users should be provided a "hotkey" tutorial on how to rapidly exit the virtual experience, and information about the nature of algorithmic tracking and mediation within any environment. Specifically:

1. This will allow not only for mandatory consent regarding the use of their personal data, but for improved trust between individuals and creators of these environments regarding user experience.
2. Work to create this tutorial/paradigm should be done with the A/IS and immersive development community to make it a standard part of the conversation from the very beginning of a project. (See Section 2, Universal Escape Key).

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Issue: XR changes the way we interact with society and can lead to complete disengagement.

Background

The increasing popularity of VR and Augmented Reality (AR) dedicated zones and their use in public sites is changing the way individuals interact with each other. Where friends and colleagues would previously emphasize eye contact and physical proximity as a way of establishing trust and a sense of cohesion, immersion may change the way we perceive the people we interact with. They may be judged based on their avatars, their ability to navigate this new reality, and their willingness to interact virtually. Barriers to entry such as for those who are visually impaired could exclude an individual from an immersive working environment or from a new connected socializing platform.

VR can also be used to disengage from one's environment. Individuals can choose to relive happy memories (whether real or not), go on vacation to a venue miles and years away, or immerse themselves in some virtual entertainment—all without leaving their chair and without interacting with other people. It is speculated this could lead to the disengagement of individuals even when in the company of others, as virtual interactions can supplement and surpass human interaction in the user experience they offer. In this way, individuals can "fulfill" their own social needs without reciprocating those of others. This artificial satisfaction of basic social needs through fully immersive technologies may have unpredictable implications on the very fabric of society, especially by changing the way humans interact (or do not interact) with each other.

XR provides such a high level of fidelity that it will challenge established policy and social norms in workplaces, homes, and in the public sphere. Especially, in regard to certain types of content, e.g., violent shooting games, highly sexualized, or illicit content, public oversight of controversial content consumption will need to be reexamined as the boundaries between real life and immersive content blur.

Recommendation

Organizations that are working on immersive technologies should create a multidisciplinary approach to ensure that technologies are not created in an ethical vacuum. By involving social scientists and humanities researchers in technological product development, ethical concerns can be identified more quickly.

Immersive content providers (including advertisers) should provide mandatory and contextual disclosure when offering alternative social interactions that do not require a human counterpart or severely limit key social cues.

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Issue: When geography is eliminated and identity morphs from physical certainty to virtuality, then cultural norms and interactions may transform in ways that supersede, supplement, or replace human interaction.

Background

When an increasing amount of our life is spent in a photorealistic and responsive world of software, what will happen to actual human contact, which might always remain undigitizable in meaningful ways? When a virtual world is vastly more pleasant and fulfilling than the physical alternative, will there be a significant population who choose to live exclusively, or who spend at least a majority of their time, in a synthetic world of their own making? Opting in and out will be central to the coming digital experiences; but what happens with the opposite—when people choose to opt-out of the physical world in favor of a virtual one?

The availability of alternate computational realities could lead to permanent disengagement from a society that can have far-reaching implications on fertility rates, labor productivity, and alter the nature of social relationships. People may choose to disengage from society as a whole, choosing instead to relegate themselves to the virtual domain.

With immersion, our notions of being will be multimodal and as such will have a societal impact in terms of culture, relationships, and perception of both the self and others. We might be able to manipulate our perceptions of time and space to experience, or re-experience, interactions that would otherwise be impossible. With alternative realities in reach, people may inhabit them to avoid facing problems they encounter in real life.

XR technology could also be especially meaningful in allowing people to create a physical appearance that more closely reflects who they are. For example, it could help transgender persons reconcile their physical appearance with their identity. At this point it is not clear that the optimal digital representation of a person is the externally observable one or one better aligned to the individual's self-image and identity.

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While the benefits of spending time in alternate realities could include increasing empathy toward others or discovering aspects of one's individuality that could positively affect a person's identity (in either real or virtual reality), there are multiple benefits of human interaction, both physical and emotional, that could be adversely affected if too much time is spent within one's own creation.

Recommendation

An integrated XR awareness framework for both technology developers and end-users should be co-created by policy makers and manufacturers within a social consensus-based framework. Such an awareness framework would be deployed by entities that create technologies, with a goal of standardizing education and literacy regarding their products. *Specifically:*

- All technology developers—regardless of their position in the product ecosystem—have a responsibility to provide clear disclosure and explanations for users regarding the augmented, virtual, mediated, or multi-mediated experiences in which end-users will find themselves immersed.
- Such awareness initiatives should involve social scientists, humanities researchers, marketers (public relations), and practitioners including emotional intelligence or positive psychology, in addition to policy makers and manufacturers. The conversation can promote research focused on the ways in which immersive applications can allow for the support and safeguarding of cultural and personal identity.
- Engagement in humanities research (history, ethics, literature, fine arts, etc.) to learn how individuals understand their identity, selfhood, culture, and shared histories. Cultural education will allow users to embrace and recognize cultural identities and their unique manifestations in XR.

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Section 2—Mental Health

While there are proven benefits of utilizing virtual or augmented reality for creating empathy in users or treating post-traumatic stress disorder (PTSD) for soldiers, there are also potential negative consequences via loss of agency, consent, or confusion about one's place in one's world(s).

Questions still need to be answered regarding the use of XR as a tool for mental health diagnosis and treatment. Thus far, a significant amount of literature has emerged indicating a positive impact on mental health and physical functioning using scientifically-informed XR applications with well-designed content delivered within the more controlled (and safe) context of the therapy setting, administered and supervised by a well-trained clinician.

However, what happens if these types of computer-mediated experiences become commodity products that are readily accessible to anyone who might self-diagnose their clinical condition and use XR treatment content as "self-help" therapy? While some might say this is not much different from purchasing a self-help book and following the instructions and recommendations therein, XR experiences may have a deeper impact on a user than reading a book.

Similar to most areas of mental health care, there is a risk that this form of self-diagnosis and treatment is based on inaccurate or counterproductive information. Another kind of problem may emerge if a clinician decides that computer-mediated intervention would be great for generating a buzz for their practice and result in more business, but has not had training in its use and safe application.

Note: The following are offered as insights from Committee members who are experts in fields relating to XR. Readers are urged to consult professionals before beginning any treatment regimen. The following is not medical advice.

Issue: The short- and long-term effects and implications of therapeutic experiences to software-driven decision making for mental health assessment are currently largely unknown and may cause harm if not addressed.

Background

A/IS-enhanced XR will generate a range of powerful applications in healthcare over the next generation, from improving medical and surgical outcomes to virtual physicians, to performance visualization for athletes. Compelling ultra-high-fidelity systems could exploit the brain's neuroplasticity for a variety of beneficial (and non-beneficial) ends, including present-day treatment of PTSD and anxiety disorders using VR.

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Being in a completely mediated environment could, for example, fool the mind into thinking and feeling as it did in an earlier stage of one's life, with measurable physiological effects. Psychological conditions often have accompanying physical ailments that diminish or disappear when the psychological condition is treated. If one accepts a positive impact of XR for changing cognition, emotions, and behavior, one has to also accept that such changes can occur that have less desirable consequences. With human augmentation, the physiological and psychological can both be automatically manipulated or adjusted based on either human or machine mandated and controlled parameters. In addition to external sensory input, internal input (implanted devices) deliver information to the senses as well as deliver medication (or nutrition) based upon monitoring emotional or physical states.

XR systems could radically affect how the mind processes and synthesizes information, and ultimately it could be a way to teach ourselves new ways to think and create content. However, the long-term effects of immersion are largely unknown at this point, and the exploitability of a person's (or a larger group's) notion of reality raises a host of ethical issues.

Creating awareness over who controls what in connected systems is critical. Even calling these new forms of technologies a series of "realities" blurs the line unnecessarily. The idea that there is anything human-authored that is "non-real" is something that needs to be explored on a cultural level. If an XR system is allowed to provide ultra-high-fidelity systems to large numbers of users, "truth" will be dictated by an increasingly homogeneous and concentrated few. Even if these systems are personalized at scale by A/IS, fundamental awareness and control need to be vested with the individual.

Thus, there are issues of concern here from both the patient and the provider side of the equation. Consequently, the mental health profession needs ethical guidelines for the safe and informed use of clinical VR applications, much like pharmaceutical treatments are managed by well-trained and qualified physicians.

Recommendation

General guidelines for the creation, distribution, practice methods, and training requirements should be established for the clinical application of XR for persons with mental health conditions and the general public. *Specifically:*

- Research conducted by qualified mental health experts is required in this area to determine how people can best approach immersion in new realities in ways they can control or mediate should potential negative or triggering situations take place. In the area of clinical practice, the American Psychological Association's ethical code provides a clear and well-endorsed set of guidelines that can serve as a good starting point for understanding and proactively addressing some of the issues for the creation and use of VR applications (see: www.apa.org/ethics/ code/#201e). Three core areas of concerns and recommendations can be derived from these guidelines (two from the APA code and one regarding patient self-help decision-making):

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1. ***"2.04 Bases for Scientific and Professional Judgments***
   Psychologists' work is based upon established scientific and professional knowledge of the discipline." Technology applications that are developed for clinical assessment and treatment must be based on both an ethical and theoretical framework and documented with some level of research before they can be accepted as evidence-based and promoted to a patient in that fashion. In an emerging area like XR, where unique and specific guidelines have yet to be established, the practitioner must be fully transparent about the evidence base for the approach and take precautions to preserve the safety and integrity of the patient.

2. ***"2.01 Boundaries of Competence***
   Psychologists provide services, teach and conduct research with populations and in areas only within the boundaries of their competence, based on their education, training, supervised experience, consultation, study or professional experience."
   Technology-based mental health assessment and treatment may require fundamentally different skill sets than what is needed for traditional approaches of clinical psychology. Increased training prior to the use of these technologies is recommended.

3. **While not cited as an APA standard, the issues regarding patient self-diagnosis and self-treatment deserve further mention.**
   Mental health conditions can be extremely complex, and in some instances, the self-awareness of the patient may be compromised. This can oftentimes lead to a faulty self-diagnosis as well as the problems that arise when the patient searches for information via the Internet, where reliable and valid content can be difficult for a non-expert to identify. The same issues come into play with self-treatment. The problems that may ensue are two-fold:

   - The patient makes errors in one, or both, of diagnosis and treatment, and achieves no clinical benefit, or worse, aggravates the existing condition with an ineffective or inappropriate technological approach that actually does more harm than good. By pursuing an enticing self-help approach that is misaligned with their actual needs or has no evidence for its efficacy, the patient could miss the opportunity to actually receive quality evidence-based care that is designed and delivered based on the informed judgment of a trained expert diagnostician or clinical care provider.

   - Incorrect diagnosis and treatment could occur if a company produces a technology-based approach without sufficient validation and over-promotes or markets it to the public as a test or a cure. This has been seen over the years with many forms of pseudo-medicine. Principles and guidelines about the promotion of an application that has the consumers' protection in mind are recommended. This issue is particularly important at the current time, in view of all the public exposure, hype, and genuine excitement surrounding XR. One can imagine new companies emerging in the healthcare space without any credible expert clinical and/or research guidance. Such companies could not only do harm to users, but the uninformed

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development and over-hype of the benefits to be derived from a clinical application leading to negative effects could serve to create the general impression that VR is a snake oil approach and lead to people not seeking (or benefiting from) an otherwise well-validated XR approach.

An example of a grey area in this domain concerns one of the most common fears that people report—public speaking. Technically, in an extreme form where it significantly impairs social and occupational functioning, public speaking anxiety would qualify as a phobia and be diagnosed as an anxiety disorder. However, since people have some level of sub-clinical fear of public speaking that they eventually get over with practice, this has been one of the first areas where widespread consumer access to public speaking XR exposure therapy software has occurred. Users can practice their presentation skills on a low-cost mobile phone driven Head-Mounted Display (HMD) in front of various types of audiences and settings. In this case, most clinicians would not show much concern for this type of self-help approach, and the potential for damaging effects to a user appears to be fairly minimal. But, from this example, can we now expect that applications will be made readily available for other and perhaps more complex anxiety-disorder-based phobias (fear of flying, social phobia, driving, spiders, intimacy, etc.), or even for PTSD treatment?

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Issue: XR creates opportunities for generated experiences and high levels of user control that may lead certain individuals to choose virtual life over the physical world, which has clinical implications.

Background

We do not have an agreement on what humans require for wellbeing and mental health. Do we require interaction with the physical world? Or can generated experiences be an outlet for those who struggle in the real world? Should we always approach a user's interaction with a system to help them work on real-world problems, or is it okay to let them get lost in the generated world? Some negative examples to consider along these lines:

- Immersion and escapism could become a problem for people who tend to withdraw into themselves, become antisocial, and want to avoid the real world. This might have to be dealt with differently depending on what the withdrawal is based on—anxiety, abuse, depression, etc.

Some positive examples to consider along these lines: XR environments could be used as outlets for people who may damage themselves, others, or objects in the physical world:

- XR environments could offer a soothing atmosphere for disabled children and adults. For example, they could offer experiences similar to "stimming" (self-stimulating behaviors) and provide relaxing music, noises, etc.

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- There could be an increase in XR therapists and counselors. Technology-based meditations and mindfulness may also begin to proliferate. This could take the form of projecting therapists and patients who are far apart into the same virtual space, projecting multiple people into the same virtual space for meetings. These methods could be used to help people who may not be able to leave the home. For example, therapists have held group counseling sessions for autistic persons inside of Second Life, reporting that group members did better expressing themselves when they had an avatar with which to participate.
- People with panic disorders and agoraphobia could be provided treatment in XR environments, providing therapists greater control over patient stimuli and care.

Recommendation

While being conscious of the risk of increasing mental health issues through isolation, it is important for technologists to assist research into these new realities (XR) as a tool to increase positive mental health.

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Issue: Users may come to harm unless they are provided with the ability to exit immersive XR environments at all times.

Background

Specific health side-effects of XR like simulator sickness and acute, momentary paralysis could leave a participant trapped inside an XR experience. Furthermore, there are still unknown effects of long-term XR immersion on cognitive functions, proprioception, and developmental epistemology.

Currently, proprietarily-developed XR technologies lack coherent interoperability which creates a highly-variable ecosystem comprised of different headsets, experiences, and interfaces; this fragmented and dynamic XR technological ecosystem, therefore, lacks standardized input control functions. Onboard functionality of Head-Mounted Display (HMD) and gyroscope-based handset motion control sensors could be leveraged to give users a way out.

A universal escape key (UEK)—similar to the notion of a kill switch—should be incorporated into all XR systems. This user-defined protocol would be activated by the participant. A UEK ensures that all levels of XR system design are compatible with such a redundancy feature that allows the capacity for participants to exit an immersive environment.

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To ensure that all participants, regardless of physical mobility, sensory perception ability, or cognitive capacity, can access and utilize a UEK, escape key system design should be multimodal, comprised of text, audio, visual, haptic, and gesture-based cues. Such a system should be able to scale to other forms of input such as brain-computer interfaces. Such a system could be designed to scale to a designated neurological impulse that creates an immersion-bypass mechanism.

Participants, however, should not be reliant on XR UEK alone. On-boarding of XR participants should facilitate a sense of self-determination and individual agency that carries through all subsequent steps of the XR experience to ensure users are aware that escape functionality of localized and episodic-specific experience propagates through the global user experience/user interface (UX/UI).

Recommendation

Further evaluation by independent experts is needed to create additional guidelines, best practices, and potential technical standards to codify and propagate the concept of XR UEK throughout the rapidly evolving technologies that comprise XR. The process should be unobtrusive, secure, and allow for the user to update depending on content type.

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Section 3—Education and Training

XR in training/operations can be an effective learning tool but may alter workplace relationships and the nature of work in general. XR is already having an impact in training, operations, and production. The capabilities of just-in-time knowledge, coaching, and monitoring suggests the promise of increased safety and productivity. But how will these technologies change the workplace, alter career trajectories, and impact and influence what, how, and why we educate people?

In addition, the definition of workplace may radically change. Remote operation and increased telepresence capabilities, combined with interactive A/IS enabling always-available expertise, increase the likelihood of collaborative workspaces that are entirely virtual and not necessarily synchronous.

There may be value in using immersive technologies in education and training. That which is experiential can provide sustainable learning in the long term. In addition, this technology could be one element in lifelong learning and assist the ability to adapt to changing job markets.

Issue: Labor regulations are not in place to protect those who carry out work in the XR space, and as such, the mental or physical well-being of workers may be adversely affected during the onset and ongoing existence of automation-oriented, immersive systems.

Background

In many workplace environments, humans share spaces and tasks with automated systems (e.g., robots and/or A/IS algorithms). As these relationships increase, there may be increased pressure on more humans to team with these systems. There are myriad issues entangled in human-machine teaming including A/IS design, human-system interface (command and control), enabling better situational awareness (sensing and understanding), and enabling trust between humans and machines.

XR can play a large part in these solutions, but good immersive interfaces and experiences remain largely elusive. Adding more data and more sensors is often seen as the solution, and yet increasing information does not improve human performance.

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XR technologies also give rise to a new level of automation, where specialized content and services, like piano lessons, personalized assistance, plant assembly lines quality control and support, or even tourism guidance, could be consumed at any given time and place. This could bring better-customized services into our lives at a lower cost and higher availability, but with it comes unpriced externalities. The virtualization of labor, therefore, is likely to negatively impact a broad class of jobs irrespective of geographic location.

Beyond revolutionizing the labor capital that is needed in a physical location, XR ecosystems will also bring about a new space to be regulated, moderated, and policed. The content review of the happenings within extended reality environments constitutes the need for human labor in the form of lawyers and other professional experts. As with social media content moderation, lawyers and reviewers will be required to best interpret platform terms of service and to develop and adhere to national legislation.

Recommendation

- Human factors need to be front-and-center throughout the design and testing process, particularly with regard not only to efficacy of the task execution but also possible deleterious effects on the human, both physical and psychological. Age, psychological state, and other demographic data should be considered for use cases and backed by research rather than ad hoc determinations.
- Governments should consider the need to keep a close watch over the automation of personalized services through technology and offer alternative education and training to professionals in fields that are expected to be affected.
- Governments should consider the need to create new research-based labor protections to protect those who may be exposed to graphic or other forms of harmful content. As leading tech companies (many of which have made forays into the XR space) have outsourced content review labor to the Global South, it becomes increasingly important for all governments to take a proactive stance to support the mental well-being of their citizens.

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Section 4—The Arts

Throughout history, the arts have been a means for human expression and often healthy escapism, as well as for social and political commentary. The imminent arrival of culturally pervasive XR technologies has the potential to dramatically impact and permanently alter the methods and tools by which artists (in all media) work. For example, A/IS frameworks used to generate artwork are becoming more accessible, which raises questions of the role of the human artist and ethical issues of authorship and creative rights. Problematizing the concepts of author and artist with regard to created works is not new in the humanities or the legal domains. However, with the rise of A/IS and the unsettled legal and collaborative standing of non-human actors, these concepts take on entirely new dimensions in the creative process. Additionally, as XR technologies will provide increasingly pervasive media through which to generate and view art, there exists the possibility of invisible algorithmic suppression of creative objects and ideas. In light of these issues, how can humanity best approach the interdisciplinary and cross-cultural impacts that the new XR artistic paradigms will offer?

Issue: When expressed in this new XR modality, there exists the possibility for certain types of art forms and/or creative ideas to be algorithmically suppressed.

Background

XR presents unique opportunities for developers, artists, and storytellers to both build upon and challenge existing modes of content creation, while helping to forge original tools and methodologies in the realization of new artistic media. VR and immersive 360-degree video borrow narrative and artistic techniques from their gaming, theater, cinema, and architecture antecedents; however, these media also present occasions for developers to fashion innovative modes of, for example, editing, point-of-view, and sound.

Using many of the current creative tools while inventing new ones, XR provides a way to use public spaces as a canvas for meaningful cultural exchange and, in doing so, affords the user a fresh way of seeing such spaces as a more open and democratic media environment. AR, in particular, presents a unique medium through which to both create and view art. In contrast to earlier artistic mediums not linked to the Internet and the Cloud, AR hardware will present an

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always-on lens through which, for example, a city becomes the canvas for digital art. Viewed through AR, digital art can become a pervasive part of human experience and potentially subject to opaque algorithmic suppression and censorship.

In an environment of transparency and policy protections, the creative community writ large can leverage XR as an instrument of new media content creation, public media production, and artistic expression, which could result in a freer, more effective use of public space, as well as a more imaginative exchange of ideas between citizens. Cultural heritage sites, museums, galleries, and increasingly, digital cultural infrastructures make use of XR, serving as an important gateway for global citizens to engage art.

However, as XR technologies will provide increasingly pervasive media through which to create, view, and interact with art, there exists the possibility of opaque algorithmic suppression of creative objects and ideas.

Recommendation

The effect of regulation with regard to industry impact, effectiveness of algorithms specifically designed to avoid bias, and the efficacy of the algorithmic transparency in the public's adoption of Machine Learning supported XR technologies should be researched and evaluated to avoid artistic suppression. Evaluation results should then be converted into actionable work with, for example, the UN's Advisory Council and other impactful policy-making entities.

Issue: The widespread accessibility of A/IS frameworks as collaborative tools for artists within XR environments obscures the lines between human and non-human agents as discrete creative entities and complicates issues of creative ownership and intellectual property.

Background

A/IS frameworks used to generate artwork are becoming more accessible, which raises questions of the role of the human artist and ethical issues of authorship and creative rights. The philosophical debate around the concepts of author and artist with regard to created works is not a new one in the humanities or the legal world. However, these concepts take on entirely new dimensions when infusing the discussion with the role of A/IS agents in new creative processes that will be deeply embedded into XR tools. The removal of physical geography in XR applications can add new layers of complexity with regard to how copyright and Internet Protocol (IP) protections are established. The interaction of algorithms, machines, and humans in XR environments further complicate attribution splits for IP (where, for example, the work of an architect for a physical structure or the owners of a building should be considered in terms of IP issues along with those creating art in immersive layers). For example, AR content overlays on existing physical buildings combines multiple layers of art/content that can be algorithmically curated and generated from multiple sources and artists.

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Recommendation

Research methods to inform the development and refinement of creative copyright should be embedded within physical and virtual environments that reflect original rights or ownership to validate, recognize, and remunerate artists for original work. In addition to research, new forms of copyright will need to be conceived and codified that are more appropriate for the highly collaborative, intermedia, and virtual environments within which many of these works will be created.

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Section 5—Privacy, Access, and Control

While concerns over personal data access abound within existing environments, the nature of the imminent pervasive and immersive landscapes of XR provides unique challenges regarding the nature of user identity and control, as well as new requirements for access and accessibility.

Issue: The nature of XR environments fosters unique legal and ethical challenges that can directly affect user's privacy, identity, and rights. Society will need to rethink notions of privacy, accessibility, and governance across public and private spaces. New laws or regulations regarding data ownership, free use, universal access, and adaptive accessibility within XR environments may need to be developed.

Background

XR's potential for persistent, ubiquitous recording could undermine the reasonable expectation of privacy that undergirds privacy law doctrine in many jurisdictions. Like other emerging technologies, it may force society to rethink nuances of the manifestation of privacy in public. Furthermore, the mobility of XR devices and systems, in particular, exacerbates challenges to privacy in spaces, such as the home, that in many regions of the world have traditionally been subject to the strongest privacy protections.

Conversely, XR creates new accessibility requirements. For example, in many jurisdictions, a visually impaired person wearing a computerized visual aid cannot legally be excluded from any place that is ordinarily open to the public. In this sense, commercial establishments may be required to allow and admit wearable cameras into their premises. Moreover, with the proliferation of surveillance (oversight), there is also a need for sousveillance (undersight). Establishments that use surveillance but prohibit sousveillance are self-serving, simultaneously watching and concealing. This creates a derogatory and hypocritical dynamic between the establishment and user. In this way, XR can represent a healthy transition from a surveillance society (where only cars and buildings are allowed to "wear" cameras) to a "veillance society" where outside in surveillance, and inside out veillance co-exist.

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Ubiquitous recording will challenge expectations of privacy and veillance both in public and private spaces. Excessive storage and data logging will inevitably create a target for law enforcement. The personalized consumption of controversial immersive content could pose challenges for effective public oversight + undersight (sousveillance) and erode the distinction between what is real and what is permissible. The ability of A/IS paired with XR to match disparate data sets will challenge a bystander's ability to control her/his public image. For example, an AR application that matches publicly available information with facial recognition will strip bystanders of anonymity without their consent.

This prompts the question of data ownership, access, and the level of control individuals have over personally identifying information when integrating these pervasive technologies into our lives. Users should have clear assurances that their virtual and physical identities can and will be protected within such virtual worlds. This applies to the accidental collection of data by XR systems to better customize the experiences and technology.

XR applications should be secured against tampering, but at the same time must remain open, e.g., so that users with special needs are free to modify systems to suit their needs. Open-source materials provide key resources for an inclusive scientific society. As technology mediates the way users view their surroundings, cybersecurity and cyber-accessibility are both vital. Unsecured applications not only leave data vulnerable but create the possibility of digital assault or false light, that is, to take an individual's personal data, and share or use it in a way that is harmful or misleading. Conversely, excessive security can be problematic with regard to accessibility and the right to repair and the right to modify one's own property.

Consider a scenario (akin to identity theft as experienced via the loss of a credit card) in which a witness inside of an immersive environment (whether said environment is AR or VR) observes a photorealistic avatar commit a crime but the avatar is depicted (cloaked) as an altogether different person (or persons) rather than who they really are. In that case, only an identity-management system would know who the true perpetrator is (meaning the human individual located in physical space subject to local laws). Under such circumstances, what will happen to the perpetrators of the crime, and what constitutes probable cause, reasonable search, and seizure? What happens to the person whose identity was falsely displayed within XR, and how do they clear their name and likeness? What access to identity-management software, recordings, and databases should each of these constituencies, their legal representatives, and law enforcement have?

As XR platforms become the gateway to certain pieces of information, developers should consider the discriminatory effects of placing information behind that gateway, especially since the display of incomplete information is a form of misuse that can lead to discrimination. If some vital piece of information is only available via XR, or only available to a particular XR sandbox, some people will inevitably be locked out of that information

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[of course, this criticism could apply to any communications technology, so the solution may be opportunities for public access (e.g., libraries) rather than design].

Equally important is barrier-free XR, to avoid ableist design while opening up the world of XR to as many people as possible regardless of physical impairments to sensory perceptions. XR experiences should include secondary accessibility options for content access like closed captioning, hi-contrast color balance, and narration options.

Recommendation

- Further research is required in assessing the implications of data collection and ownership within XR environments.
- Informed consent and existing best practices for user data need to be updated to incorporate specific vulnerability issues of users within XR environments.
- It is incumbent upon technologists to educate the public on the benefits and potential for abuse of XR using or being based on A/IS.
- Experts in the areas of concern (legal experts, advocates for those with disabilities, etc.) should be included in research, policy, and manufacturing efforts.

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