

Augmented Reality as Experimental Art Practice: from Information Overlay to Software Assemblage

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Abstract

In a general technical sense, Augmented Reality (AR) is considered as primarily a virtual overlay, a datafied window that situates visual or textual information in the physical world. In contradistinction, AR as experimental art practice activates critical inquiry, collective participation, and multimodal perception. Experimental art deployed in the AR medium is contributing to a reconfiguration of traditional perceptions of interface, audience participation, and perceptual experience. This paper explores such experimental AR art practices as examples of 'software assemblage,' a materialist conception that facilitates the movement of AR beyond the conventional empirical borders of the engineering world and toward a poetic re-configuration of AR as experimental art practice.

What is 'software assemblage'?

This research posits that some of the new hybrids advanced by artists, critical engineers and programmers in the emergent field of AR art, can be understood as 'software assemblages,' a new formulation that draws on the machinic assemblage [1] as well as materialist conceptions of relational or ecological systems, such as those advanced by Mathew Fuller, Adrian Mackenzie, John Johnston and Ulrik Ekman. I will be suggesting that using the concept of 'software assemblage' in relation to AR, as a particular permutation of software as interface, introduces a materialist media perspective into the discussion and practice of AR that has been lacking to date.

Applying a conception of software assemblage to AR allows the development of self-organising dynamic systems, where the participant is integrated as a material element through their bodily movements. For the participant, AR as assemblage encourages sensory engagement that diverges from a purely visual mode, leveraging embodiment, perceptual judgment and physical interaction to generate re-assembly in the system. Art experiences that interpolate the participant in extensive (outside the frame) and intensive (sensorial) compositional modes, explore AR from a new paradigm. This new approach eschews the dominant 'information overlay' design paradigm in favour of a processual encounter between participant and artwork. AR as experimental art inhabits a different topology to that of AR as information overlay, coalescing around notions of dynamic self-orga-

nising systems, relational forces, a deep capacity for re-assembly and collective participation.

Deleuze and Guattari attacked the problem of how to provide an adequate account of the forces, flows and intensities operating on the contiguous parts of a dynamic system. Their discussion located the compositional drive of a material flow in self-organisation: primarily, a system of material elements drawn from a common technological lineage would achieve organisation by way of procedural operations vested in movement, intensity, scale, and flux. These systems were described as assemblages, since they meshed existing materials together in unexpected ways, allowing highly unique connections to emerge. Dynamic and provisional, an assemblage has a side facing 'vertical content' (control, authority, stratification) as well as a side open to new connections with other machines of expression, so that the shape of an assemblage is never fixed but always engaged in movements of re-assembly. Deleuze and Guattari note: 'We will call an assemblage every constellation of singularities and traits deducted from the flow — selected, organised, stratified—in such a way as to converge (consistency) artificially and naturally; an assemblage, in this sense, is a veritable invention [2].'

An understanding of assemblage facilitates an examination of the material elements and relational forces that coalesce in some of the new types of hybrid mixed reality situational artwork emerging from the AR medium. Imbued with a micro politics that explicitly values and enhances qualities of experimentation, participation, and critical inquiry, software assemblages challenge the accepted industry driven perceptions of AR as information overlay, and perhaps can operate to undo some of the trivial paradigms that have beset AR in fields such as mainstream gaming and entertainment. AR by artists presents a creative opportunity to eschew the restrictive commercial products of the AR medium and re-position its associated technologies like Portable Media Devices (PMD's) or the Head-Mounted Display (HMD).

The problem of the information overlay

The AR medium has not been previously analysed as an assemblage. Rather, three major modes of discussion can be found in the literature: first, in technical and engineering papers, as an 'information overlay' to a physical

space; second, following on from some aspects of this, as ‘remediated’ interface for hybridising relations between digital and physical spaces; and third, in art and design literature as a form of visual or textual simulation where physical world attributes are translated to virtual timespace. From a technical perspective, AR is any technological system which combines real and virtual, is interactive in real time, and is registered in three dimensions [3]. Caudell and Mizell [4] coined the term ‘augmented reality’ to describe the visual and textual layer inflected to the heads-up display (HUD) they adapted to display virtual information over structures manufactured at Boeing. Over the next ten years, potential applications in engineering allowed AR to emerge from under the motherly skirt of virtual reality (VR), to achieve its own standing as a distinct medium. However, the problematic transposition of the technology and concepts from an engineering paradigm to more culturally aligned fields is illustrated by the persistence of the information overlay approach.

Two examples from the commercial world illustrate AR as information overlay. Wikitude is an interactive map registered in real space via a screen display or PMD to assist in precisely locating a geographical point of interest. Cartographic and geo-localation information is held on a web server and transposed to the local space of the user. From the mobile game industry, the massive multiplayer game Ingress, invites players join one of two pseudo-militarised factions and cooperate to build virtual portals whose instantiation asserts dominance over real space. Many of the design patterns currently deployed in the mobile AR industry proceed from the assumption that the digital screen is somewhat of a transparent analogue to a window: Wikitude is literally an overlaid map, while for Ingress the smartphone screen becomes a ‘portal’ for the player to look through. This has led to a situation where the weight of industry-directed AR research, is focussed on what happens within the frame of the screen, or the HUD/HMD.

While the technology used to create AR experiences has been thoroughly researched, what is lacking is an understanding of how AR can be utilised in a way that extends beyond a technical coding as an information overlay. Taking a materialist approach, rather than focusing on either the concerns of industrial or entertainment design mentioned above, allows this research to explore AR from the perspective of the actual relations instantiated by this new artistic field, as compositions of sociality, technicity and agency at the aesthetic edge of human-computer interaction.

AR and media art theorisations

The passage of AR from engineering toward art and design has produced two influential approaches: the first merges the theory of ‘remediation’ [5] with mobile AR, originally using the HMD and more recently the PMD; the second applies a semiotic approach that transposes the real world to the virtual, producing perceptually challenging gallery-based experiences [6]. Both are aimed at constructing a believable or seamless story out of virtual material and as such are broadly narrative approaches. Pioneering research by computer engineers turned AR designers, such as Billinghurst and Kato as well as

McIntyre and Bolter, assisted in re-positioning AR in the contexts of education, entertainment, museology and, of course, new media art. Bolter and Grusin’s theory of ‘remediation’ was strategically applied in McIntyre and Bolter’s research, with the explicit goal of applying that concept to develop AR as a relevant new medium. Bolter and Grusin viewed historical recombination as a primary and defining technique of new media, rather than being seen as one potential material element in a cultural formulation, as in theories of assemblage. They note: ‘What is new about new media comes from the particular ways in which they refashion older media and the ways in which older media refashion themselves to answer the challenges of new media [7].’

Remediation, as applied to AR, seeded the aspiration that this new medium could be made to operate like its traditional media predecessors, and that a recourse to familiarity would assist with capturing an audience. However, while the theory of remediation was intended as an exploratory paradigm to extend AR’s industrial boundaries, its conceptual maxim — that new media always referred back to its antecedents — functioned to hinder AR’s passage away from the engineering trope of the information overlay. In addition, following from remediation, content is restricted and selected according to its perceived relevance to what the researchers describe as a cultural frame of shared expectations. McIntyre and Bolter state: ‘A user’s expectations are (implicitly and explicitly) based on their experience with ... all media forms; a lifetime of experiencing film, stage, tv, and so on creates a starting point for their interpretation and understanding of any new experience. Understanding, and leveraging, the shared cultural expectations of the intended audience will allow us to create richer, more engaging, and more understandable AR experiences [8].’

In addition to the problematic of producing distance from (yet still referring back to) engineering, and the perhaps even thornier issue of how to determine an audiences’ ‘shared cultural expectation,’ pictorial goals implicit to remediation such as linear perspective proved highly contradictory in a mixed reality scenario, where a technical capacity to convey seamlessly placed augments was limited. Borrowing techniques from mediums such as film also proved difficult, since from a user perspective the experience is quite different: the body is generally static and seated viewing a film, yet active and mobile when experiencing AR. In addition, the HMD’s used to access these scenarios were inherited from VR technology, and designed for immersion. Today, our most prevalent mobile device is the smartphone, whose diminished scale discreetly nests a screen in a much larger perceptual world.

Remediation takes the interface as an object, either a ‘window’ or a ‘mirror’ [9]. This analogy advances a highly structural approach that considers an interface as primarily a surface, that is either looked through to reveal content or has ‘doubled’ real world content reflected on it: in both formulations, the edges use linear perspective to pre-compose an alignment with the real world qua framing. Technical ensembles that bring devices, augmented content, and user into connection are modified in response to the qualities incorporated to the new medium from established forms. Researchers who take remediation

tion as a guide encourage an explicit shaping of AR by earlier concepts such as those found in film, television, and stage production.

AR and contemporary design research

Another significant approach from the intersection of computer science and design, is found in work emanating from the EPFL+ ECAL Lab in Lausanne, Switzerland. There, Henchoz and Lepetit note that since Nineteen Ninety-Two, AR as a field has been developed through scientific research, demonstrations and specialised conferences, however in order to leap to the mainstream as a creative medium, it needs to embrace communicative simplicity and ease of use. Their chief contention is semiotically vested: if augmented reality is to shift beyond its current status as simply a 'technology' to take on that of a 'media,' it needs to communicate as a 'dedicated visual language' containing attributes of grammar, syntax and the potential for developed narratives. They cite the need for a 'natural' integration of the user into the experience, as well as consistent visual language between physical and virtual worlds, such as Camille Scherrer's 'Le Monde des Montagnes' installation¹ which used the paper cutout as a trope to segway between a physical book and its digital augments. While the theoretical approaches outlined by Henchoz and Lepetit, and explored in the practical research output of the EPFL + ECAL Lab is less linear and more experimental than remediation, it does express some shared concerns. For example, the idea in remediation that achieving familiarity by leveraging shared cultural concerns will assist in drawing an audience, resonates with Henchoz and Lepetit's principle of creating visual consistency between real and virtual worlds. Furthermore, the models of interface proposed by Bolter and Gromala, where interface is either window or mirror, also holds in EPFL+ ECAL research, in regard to the notion of doubling the real world into the virtual to simulate a consistent semiotic flow.

Experimental AR and materialist currents

While the existing perspectives from computer science and engineering, as well as art and design practice mentioned above have taken different but related approaches to re-situating AR toward creative applications, their trajectories still primarily concern the information presented within the boundary of the screen or display, and neglect the significant relations occurring outside, such as the user's relation with the environment, the network, and the device itself. My research takes the position that approaching AR as an assemblage rather than an information overlay, and concomitantly, an interface as a network of relations rather than an object, produces a more nuanced understanding of the relations between devices, software, artists, artworks, and participants. Before we can arrive at an adequate theoretical expression of the affordances and capacities of AR as an experimental medium, software needs to be articulated not as a product or object, but as a processual element in a materially entangled yet relational system.

Looking at software as an assemblage, theorists like David Berry and Adrian Mackenzie have developed an understanding of code as more than simply a series of

repeatable, executable commands, an approach where software, along with its technical elements of data, code and algorithms, forms the procedural ground of digital mediatic assemblages. David Berry [10] has a useful conception of code as 'computational logic located within material devices', where code produces a series of materialities conjoining the activities of the end user, the creative writing of the programmer, and the devices that run executable commands, together as a relational system which can be deployed in any given cultural milieu, with quite specific affects. Following Berry, code, when embedded within technical devices, takes the role of organising agent, articulating the nuances of the medium and linking those nuances to software agents, applications, and user behaviours. AR — produced by such conjunctions of algorithms, code and software — is a particular instance of computational logic deployed on technical devices, and as such needs to be explored for its relational and material connections to a social and technical assemblage.

Experimental AR artworks that can be understood as software assemblages include Blast Theory's *Uncle Roy All Around You* [11], Janet Cardiff and George Bures Miller's *the City of Forking Paths* [12], Julian Oliver's *Level Head* [13], and Tamiko Thiel and Will Pappenheimer's *Biomer Skelters* [14]. All are iterative, that is, they produce multiple versions of themselves, with the result that the work never unfolds the same way twice. Iteration, or put another way, re-assembly, is a significant quality of the machinic assemblage, one that occludes the formation of models or repetitive design patterns. *Uncle Roy All Around You* and *Biomer Skelters* both mobilise user participation and agency to shift the work as it unfolds; in the former, the participant must trace the elusive Uncle Roy and attempt to converge their path with his; in the latter, the shifting pace of the participant's heart beat effects the growth of a virtual organic biome. *The City of Forking Paths* uses the virtual qualities of AR to situate the participant in a confusing perceptual relation to a parallel world, where participants use their mobile phones to follow the artists' shamanic narrative as it meanders through The Rocks, Sydney, while Oliver leaves the source code and instructions for producing a version of *Level Head* on his website to enable the user to turn programmer/critical engineer. A material approach facilitates an understanding of the temporal and spatial relations used to generate new events emerging at the conjunction of human and technical assemblages. If we only see AR as an information layer, we miss its capacity to provoke multimodal perceptions, the embodiment present in user behaviours, as well as the contextual shifts produced by the re-purposing of PMD's as 'media assemblages' [15] and the shifting role of the passive viewer turned active participant. For example, Cardiff and Miller's *the City of Forking Paths* places the participant in a situation where they must follow the audio-visual logic of the AR embedded video, along the exact cartography set out by the narrative, and are completely unassisted by the normal technical aids used in AR such as Global Positioning Systems (GPS). Participants trace the multiple narrative flows presented by the work at the same time as main-

taining an awareness of their geographical context: if they deviate from the ‘forking paths,’ they lose their place and are caste adrift from Cardiff and Miller’s parallel perceptual universe. In this way, the work operates alongside each person’s unique sensory apprehensions, foregrounding the role of the body in producing a mixed reality experience, not the role of the technology. While the above mixed reality artworks cited here are certainly not an exhaustive list of the field, these examples serve to convey the differences between the industrial and artistic threads of AR.

Theorists like Mathew Fuller and John Johnston have explored the notion of assemblage as a compositional force that allows diverse material elements to coalesce according to particular affordances, intensities, flows and attractions. Matthew Fuller referenced Deleuze and Guattari’s assemblage as a force for the self-organisation of matter-flows concerning people, materials, devices, cultures, all interconnected and entangled as a mediatic ecology, such as that present in London’s pirate radio scene of the 1990s [16]. Fuller’s ecology traced the dynamism of such transitional and provisional assemblages, and in particular showed how the consumers were now often also producers (radio disc jockeys, artistes) of music. For Fuller, assemblages are the procedural driving force of a re-invented ‘media ecology,’ they are imbued with a persistent capacity to re-assemble, and do not concretise since they are in constant motion.

John Johnston has developed the concept of ‘computational assemblage’ to ‘designate a particular conjunction of a computational system and a correlated discourse [17].’ That computational system is cybernetics, artificial life, robotics, and autonomous software agents, while the theoretical discourse is assemblage theory as a processual mode of tracing the emergent and connected behaviours that lie behind organic and non-organic life. Johnston extends these ideas in relation to self-organising machines, from a framework he has termed ‘machinic philosophy.’ Johnston’s use of the term ‘computational assemblage’ is specifically in regard to his work on self-organising, semi-autonomous machines and their associated software agents. However, it is of significance to my term software assemblage because Johnston’s project re-situated AI and robotic agents as assemblages engaged in radical forms of becoming. This marked a critical turn away from an object-based notion of semi-autonomous machines, as becoming (seen here as a machinic articulation of complexity) pays respect to change, transformation, and singularity, allowing Johnston to more accurately trace the trajectories machinic life is taking as machines increase in complexity toward states of self-organisation [18].

Returning to the conceptual trajectory identified earlier — from information overlay to software assemblage — the capacity to self-organise, is a key quality that separates the software assemblage from the information overlay. For example, the mobile AR artwork *Biomer Skelters* uses the participant’s physiological data — derived from a smartphone fitted with a heart rate monitor — to grow a virtual biome in physical space. As the participant walks, their

heart rate increases, and this increase triggers virtual plants that appear to populate the adjacent area. As the participant moves the camera/sensor, they perceive a biome appearing around them in real time, generated by the nuances of their heart rate. Using the sensors in a PMD to measure the physiological data that subsequently articulates real time actions in the biome, creates a self-organising system conjoining real and virtual to participant, mobile wireless network, and device.

Materialist thinking — of the kind practiced by Fuller, Berry, Johnston and others — has re-positioned the interface from its object-like status as a surface (or surface of a ‘thing’) to a more open relational assemblage that can provisionally facilitate the generation of complex inter-related concrete and virtual world systems. Thinking AR as a material and relational topology is an ecologically inflected strategy that affords a position where research can remain open to shifts in AR as a dynamic system, interconnected with a range of entangled matter-flows. In the near future, this research will explore: a multimodal sensory engagement with the software assemblage as situational artwork; embodied behaviours emerging from ubiquitous computing; and the role of mobility in creating a non-visually privileged experience in the AR medium.

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