PolySocial Reality: Prospects for Extending User Capabilities Beyond Mixed, Dual and Blended Reality

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ABSTRACT
The technology industry has evolved over the years with a development lens increasingly focused on end users and usage cases. Indeed, for the past decade or more, personas (the designer-created profiles of end users) have become stand-ins for various usage cases and user models. With regard to location aware software and mobile applications, the usage of Dual Reality and Mixed Reality as metaphors have functioned in a similar vein. Just as personas are not people, Mixed and Dual Reality do not fully represent or address the complex usage cases developing as more people do more things, with more software at more times and in more spaces than ever before. This new complex application ecosystem presents greater opportunities and challenges for application design. We discuss ways that developers can use PolySocial Reality (PoSR) to represent a more complete complex structural model of individuals interacting within multiple environments.

Author Keywords
Time, Space, Asynchronous, Ubiquitous, Pervasive, Dual Reality, Mixed Reality, Blended Reality, PolySocial Reality (PoSR), User Experience Design, Interaction Design

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H.1.2 [Human Factors]: Human information processing; J.4 [Social and Behavioral Sciences] Anthropology; B.4.3 [Interconnections (Subsystems)]: Asynchronous/synchronous operations; K.4.1 [Public Policy Issues]: Transborder data flow; K.4.3: [Organizational Impacts] Computer-supported collaborative work

INTRODUCTION
To fully exploit location awareness, future interaction design development for the User Experience (UX) will be increasingly directed by users as they create new capabilities situated in social, physical, and network space [1][2]. A conceptual understanding of the global interaction context within which people experience the social mobile web is needed, one that emerges from the aggregate of multiplexed data pathways connecting interacting individuals[3].

At the moment, interaction models tend to be based on fixed navigational pathways and single narratives. Future UX development for location awareness must provide environments for sociability and shared experiences within a multiplexed environment.

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COMPLEXITY AND THE SOCIAL MOBILE WEB
People must be social to survive. We are dependent on each other and the systems that we build with each other to exist. Edward T. Hall wrote, "Man and his extensions constitute one interrelated system," [4]. As much as we'd like to separate that which is 'social' from that which is in the environment, we cannot, for these are interdependent.

Originally, Social Media apps provided a network 'place' for people to simply connect with others and share media or text [5]. Now, the addition of mobile data devices, and/or smart phones, with location-aware apps (the social mobile web), has enabled people within this system to create and utilize new capabilities. These include being able to publish, broadcast and share their locations, earn badges, points or discounts for disclosing this information, and track the locations of others who are also members of these applications, and who share or contribute to their various schemes. Many people find that they are able to increase their social time by finding friends gathered at specific locations.

Thus, social mobile web apps based on connections that might be distant in time, space (locational framework, coordinate space, etc...), and place (location, local context) offer overwhelming opportunity and choice for people to communicate, collaborate and connect with each other. Furthermore, when using social mobile web apps, people are only partially engaging in shared common networks at any given time [2][3].

For the developer, there is much more to support. Because the people using these apps are innovating their own usage cases with these new capabilities there is a need for support for these people as they move through each new usage case. When the developer doesn't consider the multiple ways people are connecting, opportunities may be missed and more importantly, people may be impaired by not being able to utilize more capabilities. This in turn could impact those interrelated systems that humans need to exist. Since the offering of opportunities and their associated capabilities is multiplexed, what can app developers contribute towards supporting this model?

One way for developers to connect to the multiplexed social mobile web user is to support the complexity of usage cases. It may seem orthogonal to do so, as most developers and User Experience professionals are instructed to create a more simple system. In this case, however, the system may need to remain complex in order to fulfill user expectations.

Science and scholarship have been driven for the past few thousand years by the need to simplify phenomena to the point that reasonable descriptions and explanations could be achieved, and impressive results have emerged. But by the mid 20th century, it was clear that the amount of detail that contributed to physical phenomena was even greater than realized before, that mathematics did not have the capacity to provide perfect descriptions of phenomena, that uncertainty was a feature of reality (not a bug), that matter, energy and information were in principle interchangeable, that observers were a part of an observed phenomena, that there were limits to the universe, and that scale mattered.

Over four decades ago these understandings were leading to a new way of creating knowledge manifest in two basic forms, both of which have slowly eroded the focus on simplifying structuralism that dominated the 20th century. One was the rise of complexity theory, possibly first popularly manifest in the work of Réne Thom on Catastrophe Theory[6][7], who in addition to the main tonic of his work, laid out a mathematical framework for describing dynamical phenomena, real and imagined. In the humanities post-structuralism (and then postmodernism) came to the fore, and turned out to be a relatively good tool for exposing the shortcomings of structuralism, but provided no means to reconcile or replace structural approaches. This approach exposed complexity, but provided no tools to address complexity, although Actor Network Theory, as popularized and elaborated by Bruno Latour shows some promise [8].

POLYSOCIAL REALITY

Applin and Fischer [2][9] have suggested PolySocial Reality as a term for the conceptual model of the global interaction context within which people experience the social mobile web.

PoSR is based upon the core concept that dynamic relational structures emerge from the aggregate of multiplexed asynchronous or synchronous data creations of all individuals within the domain of networked individuated networked or local experiences. In other words, PoSR describes the aggregate of all the experienced 'locations' and 'communications' of all individual people in multiple networks at the same or different times.

For example, a PoSR context emerges when a person is walking down the street and talking on the phone and texting and another person is doing the same thing with them while both parties may be communicating through different channels to other people as well. Or when a person enters an environment and checks into foursquare which delivers a tweet and a Facebook update notating their location while another person responds to that in real time. The transmissions between people are fragmented, and PoSR describes the relationship emerging from these fragmented transmissions. PoSR describes the network transaction space that humans are inhabiting themselves and with others in order to maintain their relationships and engage in new activities with collective dependencies via the social mobile web. Thus, multiple-channeled network interactions lead to complex relationships with others.

If a person is processing multiplexed data creations and another person is processing others, and both people come together, how is commonality determined by and between the parties? If a third person joins in, how are they able to sort out where there is common ground? PoSR space can get very, very complex, pretty quickly.

As a interaction context, PoSR has positive and negative outcomes. A potentially positive outcome may be an expanded social network, a negative outcome may be that those expanded social networks are connected by small, single dimension attributes. Another may be that the fragmentation of PoSR encourages individuation, which makes it more difficult for humans to be social (and cooperative) with one another, even as they effectively have a larger social network. While implementations continue to focus on individuated orientations, this can further compound that problem.

To the extent that people share common sources of information while interacting with each other, the greater their capacity to collaborate. If they share too few channels relevant to a common goal, there may be too little mutual information about a transaction to interact and communicate well collaboratively. Poor collaborative interaction can lead to further relational fragmentation with the potential to promote individuation on a broad scale. By changing the means that humans use to manage space and time during their daily routines, developers can shift our experience from individuated, user experiences to enhanced sociability within a multi-user, multiple application, multiplexed messaging, PoSR environment.

We are not arguing against individualism, but promoting people's ability to control and augment their individual context through leveraging the elaborated collective capacities that defines humanity and enables individuals to create productive innovations.

COMPLEXITY AND MEDIATED INTERACTION

Our main purpose is to try to make more concrete how developers might leverage PoSR contexts to to create more dynamic complexity aware applications. As a stage towards a typology, Table 1 is a set of reference case types representing levels of Agent/Technology Interaction, with an indication of user applications and considerations for developers in supporting and extending these.

The table is organized around cases as: a) the mix of people and technology involved in a technology mediated activity; b) the basic user context with respect to problems and solutions; and c) the concepts and technologies a designer or developer might bring to the problem.

While not explicitly represented, the table is shaped by designer/developer approaches with respect to structured, object-based and agent-based technologies.

Case 0 is meant to set a baseline, and might include the archetype hacker who uses and composes a set of technologies with only functional contributions by other designers/developers. But it could also represent more ordinary people operating simple independent appliances like

an alarm clock or VCR remote control to achieve results. Cases 1 and 2 represent most conventional applications where a UX is essential to enable more people to engage in the aggregate functionalities of Case 0, where an important part of the application is the metaphor or framework developed by the designer and implemented by the developer. While Case 1 might be based on structured development methodologies, Case 2 would tend to depend on object-based design for more than abstraction to effectively represent the required complexity in the agent/technology interaction.

Case 3 represents where most location aware applications are focused, where object-based approaches with inclusion of some agent-based technologies is needed to represent

Mediated Interaction	Interaction Layer	Developer/Designer (D/D) Layer
CASE 0	**Individual using a Technology**	**Single User/No UX**
Single person interaction with technology Context Free	• Analog or Digital things	• No load on D/D to explain or instruct beyond original implementation. • Functions and Operations. • No directions for usage • Minimal or no UX (e.g. Libraries or simple shell)
CASE 1	**Passive Integration of Technology with Local Environment**	**Single User/Addition of UX**
Single person interaction with technology In static environment Context Sensitive	• Designer access to environment is passive. • Users create contextual information, such as setting system clock, providing ID information, etc... • User interprets/ conforms to system metaphor to interact with program. • D/D sets up environment by forcing user compliance and through inferring contexts of use from user supplied information.	• Passive approach to local environment based on user input. • Make inferences that certain information about environment will be available from user. • D/D sets up environment by forcing user compliance to a system design, usually through some model metaphor (e.g. Form, GUI or Externally provided UX). • No assumptions for many possible contexts of use. • Object-based for abstraction.
CASE 2	**Active Integration of Technology with Local Environment**	**Single User/Non-Interactive Services/ UX Active**
Single person interaction with technology In dynamic environment	• View reports or observe technology outcomes based on dynamic data gathering relating to local environment • Limited interaction with external context-free network services.	• Program behavior can be modified based on information gathered. • Recognition of changing locations and other circumstances. • Modification of environment by the technology • Dynamic objects for emergent results.

CASE 3	Interaction Between Environments	Single User/ Interactive Services/ UX Active
Single person interaction with technology In local and remote environments [3] Dual Reality model can work	• Interactive services • Interactive exchange of information between contexts • Relationship between actions and outcomes in different environments. • Limited asymmetrical communication	• Service integration • Several environments can be modified as a result of the technology. • Aware of multiple use environments • Facilitate limited communication • Programming is a hybrid, mostly object based with some agents.
CASE 4	**Social Apps: Interaction Between Individuals within their Environments**	**2+ Users/Interactive Services UX Active/ Multi Place/ Homogenous People**
2+ familiar or similar people interacting synchronously or asynchronously. PoSR begins as a design consideration (PoSR less disruptive)	• Social interaction direct or indirect between two or more people. • Relatively homogenous individuals or individuals within a limited consistent set of roles. • Similar, but different, environments between interactants.	• Aware of multiple individual participants. • Support cooperation, groupware • Awareness that the technology partially defines the amount of detail available to each interactant [3]. • Awareness: users must infer missing information about others' contexts • Users as agents
CASE 5	**Social Apps: Interaction Between Differentiated Individuals within their Environments**	**2+ Users/Interactive Services UX Active/ Multi Place/ Heterogenous People**
2+ diverse people interacting synchronously or asynchronously. PoSR is fully functioning here PoSR is disruptive here	• Social interaction direct or indirect between two people • Differentiated individuals on language, culture, status, etc. or individuals within a diverse set of roles • Highly differentiated environments • Differential knowledge	• Details about the context of others are missing and may be difficult for individual users to infer or details that cannot be inferred. • Highly complex elements of differentiated environments are combined into structures that appear different from each users' POV. • Users as distributed dynamic unique agents.

Table 1. Actor/Technology Interaction Cases

interactions between multiple environments and their manipulation, while still limiting consideration of how different users might contribute to the success or failure of the application. Dual, mixed and blended reality are probably sufficient for this level of interaction.

Cases 4 and 5 represent where we think location aware applications are going based on present user generated applications. Effectively, in addition to all technologies in use, all users themselves become, at least in part, agents in the application and thus fall, in part, within the designer/developer responsibility [10]. The more complex model associated with PoSR is required here to coordinate this information. The main difference is in assumptions of homogeneity of agents and their activities assumed by the designer/developer. Case 4 assumes they are similar or very structured in differences. Case 5 is considerably more ambitious as it requires much more information be available to both the application and the users since it cannot easily be inferred or imposed by either users or designer/developer, but will ultimately be required to extend advanced user created applications to a broader group of end users, an ubiquity necessary for an application to be truly social. Elements of Case 4 are probably reflected informally in location aware applications, but will benefit from formal inclusion.

One possible approach consistent with our proposal is to adapt Auber's [11] anoptic representation. Auber argues that the collective intelligence of a group develops only to the extent each individual has access to at least one form of representation of the group's activity that includes all members in some form, varies with members activities and is considered legitimate by all. It need not look the same to everyone: each may have their own projection.

CONCLUSION

Concepts such as Dual Reality and Mixed Reality, and their subsequent technologies were sufficient for most location aware applications, but not sufficient to meet the opportunities and capabilities that location aware applications are opening up. PoSR is capable of representing these relationships, while including multiple users' relative viewpoints.

One approach to implementing applications corresponding to Cases 4 and 5 is to develop anoptic representations based on additional model agents that partially direct and coordinate activities of the user agents by establishing model 'best practice,' mediate communications and explicitly gather, seek and communicate information required by all parties in collaboration with users or their agent representations. In this manner the connections represented by PoSR can be managed with respect to positive and negative outcomes.

Simple examples include plotting people and their attributes and activities on maps. But even with a dynamic legend and the capacity to navigate through the history, this is limited. Bluebrains [12] constructs a soundtrack from fixed pieces associated with specific locations that people can interact with in a non-linear way. The agency of the individual creates the resulting soundtrack, which is tied to the locations visited. Again this has limits.

An appropriate means of representing PoSR-based descriptions should include creating some form of dynamic commentary constructed from any combination of visual, aural or language-based elements that can be modified, rescaled and browsed by end users to find information they require from the present or past about others they are interacting with directly or indirectly in a compact form.

PoSR descriptions offer location aware applications a tractable means of traversing the complexity of single and multiple user experiences while maintaining the complexity required by users to construct further applications of the technologies they employ.

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