

Chapter 1

The Internet of Places at Community–Scale: Design Scenarios for Hyperlocal Neighborhood

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ABSTRACT

The Internet of Things integrates entities of the physical world by making them addressable through the Internet, and making the Internet accessible through physical objects. We draw on our own previous design research in community informatics to explore a critical elaboration of the Internet of Things: The Internet of Places (IoP). IoP seeks to support awareness, engagement, and interaction pertaining to individual and collective human experiences, meaning making, activity, intentions, and values by computationally leveraging and integrating a wide range of human data with places to which those data refer. We describe design scenarios, prototypes, and user research at the scale of local community. We identify a critical alternative for humankind of hyperlocal community, enabling greater citizen awareness, engagement, participation, and power. We suggest that the Internet of Places at community-scale is the next generation infrastructure for community networks in the 40-year tradition of the Berkeley Community Memory.

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INTRODUCTION

In the 1960s, the futurist Marshall McLuhan (1962) envisioned a “global village”. A version of this future is here. The Internet brings all people closer to one another. Much contemporary innovation is directed to unprecedented cloud resources and services, and the Internet mediated, massive-scale educational, recreational, social, and professional interactions they afford. We are just beginning to fathom this trajectory toward a global village of humankind.

In this paper we explore the thesis that the global village requires local communities to provide social foundation for more complex and distributed societal institutions and capacities (Carroll, Shih, & Kropczynski, 2015; Perera, Zaslavsky, Christen & Georgakopoulos, 2014). In particular, we draw on the thread of research inaugurated by the Berkeley Community Memory (BCM) (Rossman, 1975). In the 1970s, before there ever was an Internet, activists in Berkeley created a mainframe system, implemented through a 110-baud link to teletype terminals. BCM included discussion forums directed at local and national issues, and online postings of community information about car pools, apartment vacancies, chess games, restaurant reviews, and musical instruments to buy or sell. People posted their poetry and essays. One of the terminals was located beneath the bulletin board in a local record store; users started calling it an “electronic bulletin board”. Activists created an online memorial to Alameda County’s Vietnam War casualties.

Rossman’s (1975) paper on BCM reported action research on universal accessibility, social leveling, and strong democracy principles that seem current 40 years onward, and that guided a long series of community network projects (Carroll, 2012; Schuler, 1996), and firmly established the design principle that the purpose of community networks is to inform and engage the community, and to enable community action. We take this work as a model inspiration for how enabling local community can facilitate the development of national and global community, as a seed crystal can enable the development of a robust, larger-scale crystal lattice.

In this paper, we describe design research on community services and information infrastructures inspired by BCM, but leveraging contemporary technological possibilities of the Internet of Things (IoT), that is, the integration of entities of the physical world by making them addressable through the Internet, and making the Internet accessible through physical objects. In our project, places in the local community are indices into a networking infrastructure for individual and community information and interaction.

It is quite useful to associate physical data with locations at which these data are obtained (Goodchild Guo, Annoni et al., 2012; Schafer, Ganoë, Xiao, Coch & Carroll, 2005). Our interests, however, transcend spatially indexing physical data; we are most concerned with the challenge of enhancing awareness, engagement, and interaction pertaining to individual and collective human experiences, meaning making, activity, intentions, and values by computationally leveraging and integrating a wide range of human data with places to which those data refer. We refer to this specialization of IoT as the Internet of Places.

Emphasizing the meanings of local places to the people that inhabit them can strengthen local community identity. The history, heritage, and special purposes of community places can be invisible even to the people who pass by them every day. Allowing community places to serve as indices into digital interactions and information makes them more visible, but also provides new ways to become aware and participate in the community. It makes community information and interaction hyperlocal (Farhi, 1991): Created by local people, about local places and events, and directed to local people to be accessed locally. This powerfully updates the electronic bulletin boards of BCM: In the Internet of Places (IoP), we do not merely refer to and discuss local places and place-based events, we interact with them

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directly, their geo-spatial coordinates are part of the underlying computation. In this sense, we argue, places can speak for themselves, host community history and heritage, facilitate community activities, mediate citizen interaction, and guide local political discussion and decision-making.

In the early 1970s, the developers of the BCM were pursuing a vision of greater equity in citizen access and participation by putting community information and activities online, and putting terminals in public spaces. New information infrastructures raise many new possibilities. According to a recent study from by Pew Internet & American Life, 56% of American adults now own a smartphone; smartphone adoptions have increased rapidly since 2011 in every demographic (Smith, 2013). According to a survey from YellowPages, nine out of 10 people “almost always” have their mobile devices with them, and most permit mobile applications to access their “current location” at least some of the time (Hendrix, 2013). People use smartphones not only as communications devices, but also for personal computing (Karlson, Meyers, Jacobs, Johns, & Kane, 2009). The especially high adoption rate among young adults is an indicator of future societal trends. New information infrastructures raise many new possibilities. Smartphones enable mobile/location sensitive information interactions not before possible (Ganoë, Robinson, Horning, Xie & Carroll, 2010; Geser, 2004; Paulos, Honicky & Hooker, 2009). We are investigating ways that “smart spaces” can enrich the range of possible mobile experiences and interactions, specifically to enhance citizen awareness of and increase participation and engagement in local activities, news, plans, and possible social opportunities.

THE INTERNET OF PLACES

In 1999, Kevin Ashton detailed the vision of the “Internet of Things” (IoT) that focuses on the need “to empower computers with their own meanings of gathering information, ... enable computers to observe, identify and understand the world—without the limitations of human-entered data” (Ashton, 2009). IoT articulates three converging visions: a vision of connected things, a vision of powerful and pervasive Internet connectivity, and a vision of large-scale data analytics (Atzori, Iera & Morabito, 2010).

In the “things”-oriented vision, researchers focus on improving the capabilities of RFIDs, sensors, or tiny and battery-operated embedded devices (Welbourne et al., 2009). These devices are capable of detecting changes in the environment and providing real-time and up-to-date information to inform better decision-making process. The sensors are typically networked in a peer-to-peer fashion or connected to a central server. In some cases, these devices are also capable of sophisticated computations. Smartphones and wearable activity trackers are already showing this trend.

In the Internet-oriented vision, researchers focus on building out the cloud-computing infrastructure (Perera, Zaslavsky, Chriten et al., 2014). Cloud-computing goes beyond the simple network transmission protocols enabled in sensors and embedded devices in that the sensors not only communicate with each other, but they are also constantly-on, and the information stored in the cloud is also accessible anytime and anywhere. Current state-of-the-art cloud-computing infrastructure focuses on improving transmission bandwidth and storage spaces so that a larger amount of information can be transferred and stored more quickly.

In the “semantic”-oriented vision, researchers focus on leveraging big data analytics to integrate semantic information transmitted by embedded devices via cloud-computing infrastructure (Ringas, Christopoulou & Stefanidakis, 2011). Trends and patterns formulate semantic meanings that can be utilized in context-aware applications. For example, depending on the user’s current location and infor-

mational needs, semantically-powered computational systems could make relevant recommendations on how to best locate the resources depending on the user's context.

The Internet of Things integrates objects of the physical world by making them addressable through the Internet, and making the Internet accessible through physical objects. This is an inspiring and challenging vision for information infrastructures.

Our vision for an Internet of Places specializes and extends the Internet of Things. We specialize IoT by focusing on a particular category of thing, integrating places as collective ensembles of physical objects that function as physical settings for community activities. We extend IoT by focusing on places as socially constructed, intentional, and contested. IoP seeks to make experiential, affective, and intentional aspects of places more visible, accessible, interactive, and sharable. IoP should support humans in place-making, help them experience and develop identity through everyday community activities, become more engaged and participate in community activities, and build effective multifaceted local social network.

Key to our analysis is the distinction between “space” and “place” (Harrison & Dourish, 1996): space refers to the structural, geometrical qualities of a physical environment, place includes the dimensions of lived experience, interaction, and use of a space by its inhabitants. Spaces become places through being inhabited, used, appropriated, and transformed in human activity. That is to say, people make places through their activity (Duff, 2010; Lee, Danis, Miller & Jung, 2001). A classic example is Hester's (1993) analysis of the town of Manteo, North Carolina, as a “sacred structure” of specialized activity hubs, places, overlaying a mundane physical space. Communities assign rich meanings to their local places and maintain a sense of place that is conceived of as being a highly multidimensional experience conveyed through environmental, social, and cultural attributes of places, in addition to people's psychological responses to these attributes (Thrift, 2004). Places are fundamental constructs that structure social practices, cultural history, memory, experiences, emotion, and material environment that people live in. The physical environment and the meaning, identity, sense of attachment and belonging are facets of places that are profoundly significant and inseparable (Green, 2010). IoP enables and amplifies the capacity of individuals and communities to interact and engage with each other through place-based infrastructures.

IoP extends visions of the digital Earth (Goodchild et al., 2012). During the past 20 years, the geo-spatial revolution has amassed a set of interlocking technologies – global positioning systems (GPS), sensor platforms (satellite images), closed circuit television (CCTV) cameras, GPS enabled devices, and radio frequency identification tags (RFID), GIS and spatial data analysis. These technologies have fundamentally changed the relationship between people and the world (Downs, 2014), making vast amounts of real-time digital data about people and places readily available, but for the most part focused on physical aspects of use and state, for example, water quality readings for a local stream posted on an interactive map (Schafer et al., 2005).

The distinction between space and place became an important design concept in the 1990s as collaborative systems increasingly employed spatial presentations and interactions, and it became critical to distinguish lower-level spatial navigation and interaction from the shared conventions, cultural understandings, and practices that socially constitute a virtual place (Harrison & Dourish, 1996).

These two lines of conceptual development converge in community informatics where place becomes one's community or neighborhood (Carroll et al., 2001; Jones, Grandhi, Terveen & Whittaker, 2004), constituted by everyday activities that shape personal identity, social engagement and participation, and multifaceted relationships.

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In the balance of this paper, we develop and illustrate the IoP concept by exploring five conjectures:

- IoP should enable appreciation of the nuance of everyday places. The incidental meanings and emotions evoked by those places can be associated with and shared through location.
- IoP should strengthen awareness and engagement in local heritage. Information, discussion, and experiences about the history of places and events can be associated with and shared through location.
- IoP should integrate community activity, making public activity more visible and connected to community resources, and encouraging diverse perspectives on local news and events.
- IoP should provide new ways to participate in community life, mediating interactions among neighbors to enrich discussion and shared activities, including giving and receiving help.
- IoP should support interactions with and participation in local anchor institutions, including municipal government, helping to make people more aware of positions and rationales regarding political issues and initiatives, and of plans for community development.

Everyday Places Are Nuanced

People moving within a community are constantly experiencing the world around them. They see roads closed for repair, buildings being restored or torn down, park gardens being groomed. Some of the experiences are salient, like noticing an approaching vehicle and stepping back onto the curb until it is safe to cross the street. Other experiences are highly nuanced, barely noticed. One person walks by a construction site and wonders what was there before, or what is happening now. Another person walks for blocks without “seeing” anything.

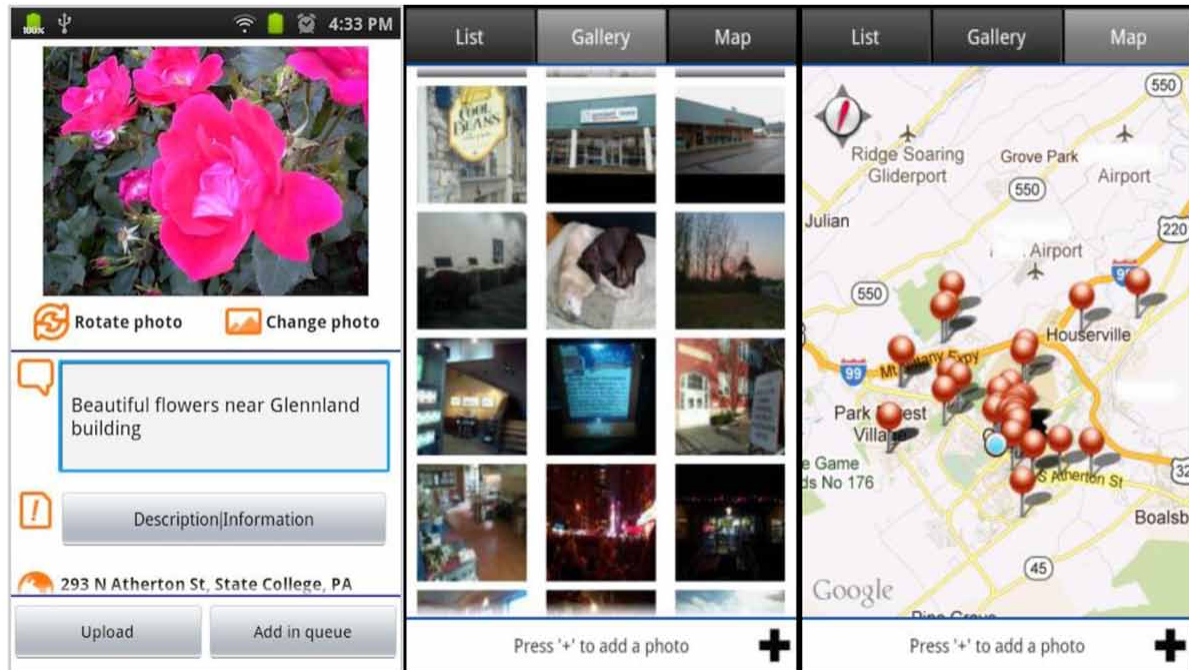
IoP enriches geographical locations by directly associating information, interactions, and services with geographic coordinates, including personal meanings, experiences, and emotions. Thus, a resident might have an emotionally powerful place-based experience when looking at a freshly blooming flower. Acknowledging, codifying and sharing an experience like this is one way for community members to identify with local places and events. Here and Now (Figure 1) makes it easier to share place-based personal moments, and to recognize the nuances of the community places that evoke them.

Here & Now extends the traditional notion of digital storytelling (Klaebe, Foth, Burgess & Bilandzic, 2007) by allowing users to upload an image of an object or activity along with a brief description using a smartphone (Carroll, Hoffman, Han & Rosson, 2015). The Here and Now contribution is geo-tagged with the person’s current location. The posts are viewable on a map, so that mobile users can find and enjoy the contributions made near their current location, or browse Here & Now contributions more broadly using a map. Once a post is selected, viewers can also contribute their own thoughts or reactions.

Here & Now photos and comments are attributed to the individual community members who contributed, reducing the chance that the system will fill up with “junk” content. As a result, the use of Here & Now requires user authentication, which we have simplified by allowing reuse their Facebook credentials. The reuse of Facebook credentials also enables residents to choose to share community activities with their larger Facebook audience.

As Here & Now contributions accrue, the associated community places begin to “speak” for themselves in a hyperlocal fashion. When people pass by, they can interact with not only the physical place, but also its digital doppelganger, bringing to light the recent special features of that place that have been called out by photos, comments, and so on. Through the interactive community map that presents Here

Figure 1. Here & Now: Add photo page (left), a list of photos posted by users (mid), and a map view of photos (right)



& Now records that are nearby, people can learn about other places that have something to say. Currently we are studying how Here & Now enhances awareness of place-based community information, and how aggregating nearby Here & Now records broadens people's sense of place-based interactions throughout the community (Carroll, Hoffman, Hanet et al., 2015).

The focus of Here & Now has been codifying and sharing feelings, meanings, and experiences. But this same service can also be quite utilitarian. For example, a photo of a pothole calls attention to the need for road repair; a photo of a sale in progress at a local store could draw customers; a photo of citizens debating a policy proposal may become part of the local news.

Heritage Lives in Places

The fleeting, ad hoc, but rich personal experience of local places that grounds the here and now of everyday life, is complemented by the history and heritage of these same places. Many places we pass now served as other places in the past. Construction sites are an obvious example; they are in the midst of becoming a new or refurbished place. A few famous spots in a city might have a plaque briefly citing a particularly notable former resident or purpose. However, most places remain silent and anonymous as to what they formerly were.

We have been studying how to bring the history of local places into the everyday lived experiences of citizens. Research has found that collective city memory (Ringas et al., 2011) – local knowledge, experiences, and people – can be leveraged as a source of empowerment that builds a city's social infrastructure (de Kreek & Oosterbroek, 2013). Working with the Historical Resources Commission of the

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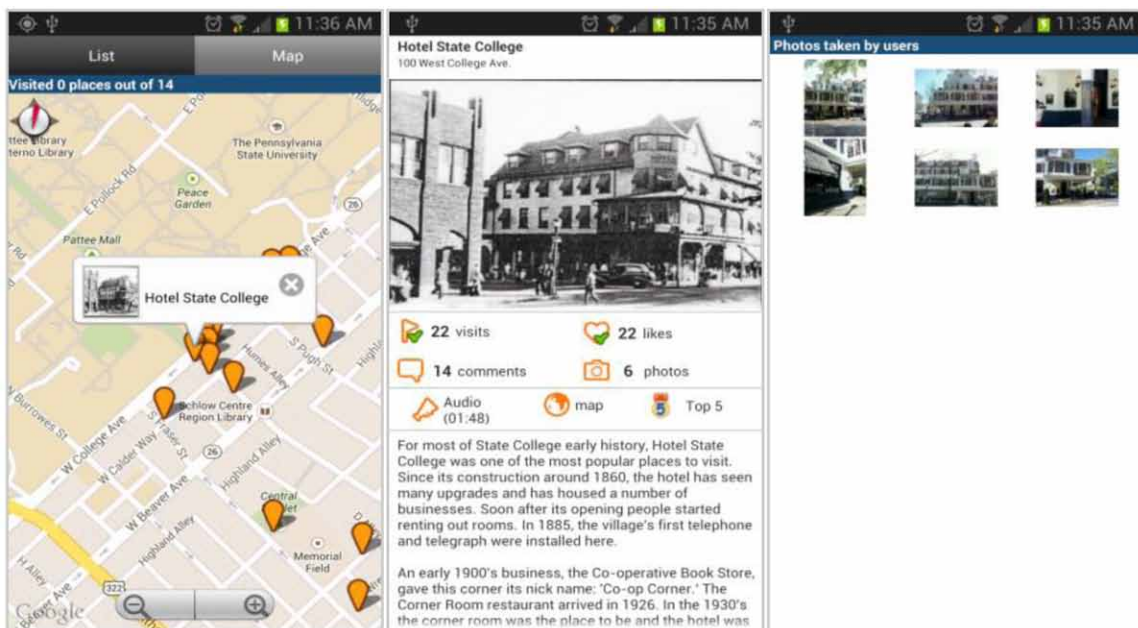
Borough of State College, Pennsylvania, we developed Lost State College, a map-indexed collection of self-documenting places (Figure 2). This service presents geo-coded photographs and other documentation for 43 historic buildings and 14 plaques in the main downtown area of State College. A person at one of these locations can view its record, including images from different points in time, the street address, textual and audio descriptions, and web links.

Lost State College also supports typical social media interactions such as visiting (check-ins), liking, commenting, and the ability to add one's own photo and caption to a place's history. Thus, at the same moment the user can engage with a place as it is now, but also engage depictions and descriptions of the place as it was in the past. The service was called Lost State College because the history of community places can be lost as it is overwritten by successive renovations and rebuilding. In this sense, the present obstructs engagement with the heritage of local places, and by so doing might undermine a sense of community identity (Carroll & Rosson, 2013; Hester, 1993).

The place histories curated in Lost State College can be accessed through an interactive map in a desktop computer, but we have been particularly interested in mobile access at the place itself, because this allows places to speak for themselves directly, presenting both their history and their embodied present to as the person is there. Being there also affords personal interaction with a place, walking around its current embodiment, and using social media interactions to explore its digital history.

After building the Lost State College mobile app, we studied local residents as they took a pre-scripted "tour" of a set of popular downtown places. We wanted to see how they interacted with the application, and hoped to understand not only their moment-by-moment usage behaviors, but also how the layers of content grow through users' posts about landmarks, paths and personal reactions and suggestions (Han, Shih, Rosson et al., 2014). Overall, we found that participants used Lost State College to both access

Figure 2. Screenshots of Lost State College: Map view (left), detailed view of the historical landmark (mid), and a list of photo taken and shared by participants (right)



official historical information and to augment the stories and personal experiences with places. The contributions and interactions from participants did indeed add a new layer to the places, transforming them into more meaningful and interactive local places that will be appreciated by both local residents and the community.

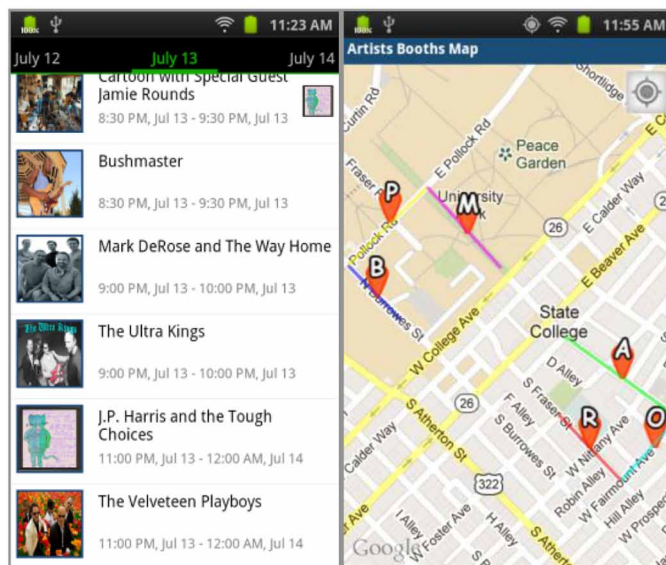
Place-based heritage preservation and sharing, as in Lost State College, illustrates hyperlocality: The place information is itself placed, that is, accessed by GPS coordinates; it is experienced in the place to which it refers. The integration of past and present within Lost State College also extends the notion of hyperlocality to include temporal layering of a place (though terminologically, it is not clear where one can go beyond “hyper-”).

Places Integrate Activities

Experiencing the IoP at the scale of a community enriches people’s activity by connecting it to community feelings, opinions, and events, and to other individuals in the community. Within this framework, places “speak” for themselves, sharing the experiences and history that they have hosted; however even more than providing a record of activities present and past, local places organize and integrate community events. Places need not simply serve as a locale for events; their structural features can be used as a rubric for how an activity will take place.

As an example of using place to integrate community activity, we have experimented for several years with an Arts Festival application for the Central Pennsylvania Festival of the Arts, held annually in State College, Pennsylvania (Ganoë et al., 2010; Hoffman, Robinson, Han and Carroll, 2012; Shih, Han & Carroll, 2015a), an extensive art, crafts and music program typically attended by about 125,000 individuals, a mix of residents and visitors. In the application, festival events are presented both as a list view and in a map view (Figure 3). The latter is an example of how places can organize activity.

Figure 3. Screenshots of the Arts Festival mobile application for community information and events: A list of festival artists (left) and festival booth locations (right)



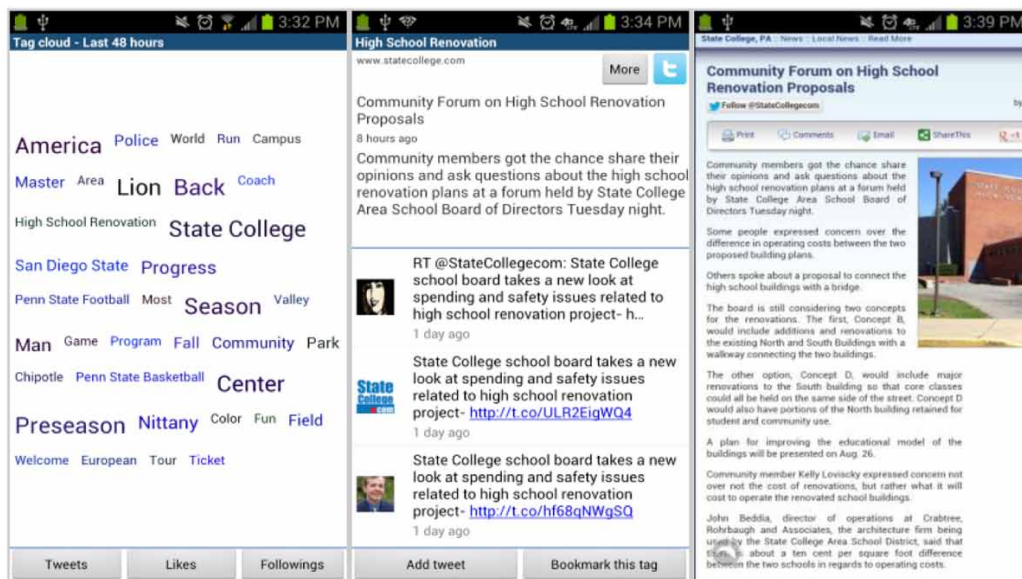
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We are also exploring how places at a coarser level of granularity, namely towns rather than buildings or streets, can provide an organizing framework for community behavior. The Local News Chatter application (Figure 4) has the goal of improving citizens' awareness of their local news, enhancing feelings of community engagement, and attracting online social interactions about the news. The core concept of Local News Chatter is to aggregate information that is of local relevance from multiple sources, and to provide supports for tweeting or commenting on the local news thus presented (Han, Shih & Carroll, 2013, 2014; Shih, Han & Carroll, 2014a, 2014b, 2015b). The sources include formal articles from local media and microblogs (e.g., Twitter).

Local News Chatter presents a tag cloud view of local news items. The tags are extracted through linguistic analysis of the news stories, with the cloud is formed to include both high frequency and low frequency words and phrases. In the cloud view, larger tags indicate popular topics; smaller tags imply lower popularity. Local News Chatter conducts a similar analysis on Twitter posts with local coordinates, combining the resulting tags with those culled from local media stories. By leveraging existing content in this way (i.e., news and tweets), the application takes a sort of "jumpstart" on adoption, for example compared to a novel news chatter tool that must build its own content. This aggregation of content (the tags serve as an index to the original stories and microblogs) helps to orient viewers, promotes a sense of "the local buzz", and is a starting ground for news discussions.

Citizens who tried out Local News Chatter in laboratory studies (Han, Shih & Carroll, 2014) generally offered positive feedback on the cloud overview and the detailed view of twitter posts about the news. The cloud view helped providing a quick overview of all local news and what is going on in the community, and was seen as especially helpful for guiding attention to less popular news. The aggregated tweet view encouraged users to comment or tweet their own opinions. Microblog posts are normally

Figure 4. Screenshots of Local News Chatter: A tag cloud presents the overview of the most recent trend of local news (left), the combined view of formal news articles and socially generated tweets (mid), and a more detailed formal news information (right)

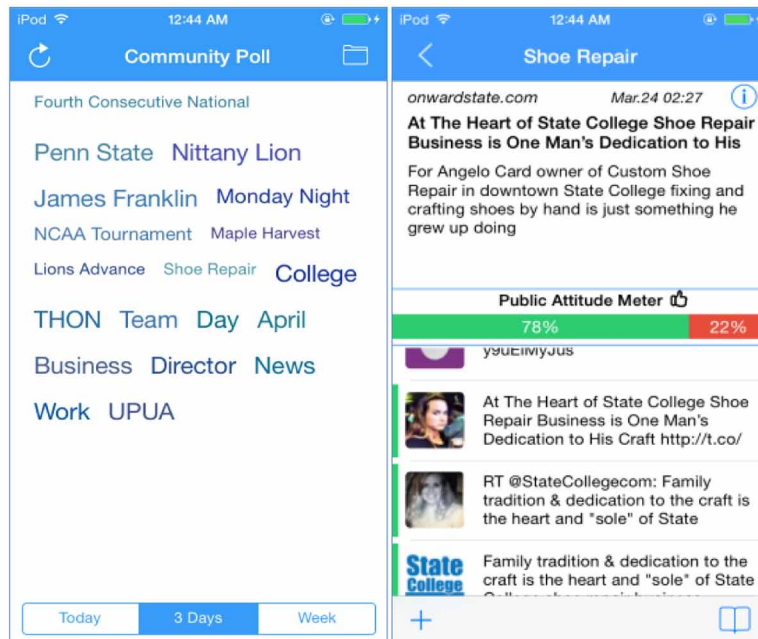


personal whereabouts information that chronicles an individual's daily activities. Any given post can be very interesting to some readers, but annoying to others. We found that connecting local tweets to local news stories in an integrated fashion created new opportunities for routing useful microblogs to local residents.

To further explore the user experiences afforded by Local News Chatter, we added a Public Attitude Meter (Figure 5). This widget calculates a "community sentiment" value by using a sentiment analysis algorithm to analyze the polarity of public opinions as conveyed in tweets about local news topics (Shih, Han & Carroll, 2014b). If the meter score is positive, a thumbs-up icon is displayed next to the text; if negative, a thumbs-down icon is shown. Each individual tweet also reflects a positive or a negative attitude: positive tweets have a green bar and negative tweets have a red bar next to the user profile image. In a user study, we found that when residents are made aware of public sentiment they feel encouraged to read local news articles and participate in social media discussions.

Our next step is to investigate how this tool would be used and adopted by a local community. We also intend to investigate the influence of smartphone affordances (such as mobility and accessibility) on reading, creating, and sharing local news information; we hope to understand people's expectations about whether and how such technologies can keep them up to date and in touch with local news, events, and activities. We are also working to extract more precise location information from the news stories and microblogs, so that we can present news content that is tied to where a user is currently located.

Figure 5. Screenshots of the added Public Attitude Meter that represents community sentiment based on sentiment analysis



Places Engage Interaction

In the 1980s, Oldenburg (1989) introduced the concept of third places as social environments that are separate from home and workplace, but essential to building civil society, democracy, and civic engagement. Third places have been co-opted by nomadic workers, who tend to work in separation at their laptops; this working style is often experienced as unwelcoming to social interactions with others. This is ironic and unfortunate because it replaces the potential for civic interactions in third places with further examples of isolation and self-imposed siloes.

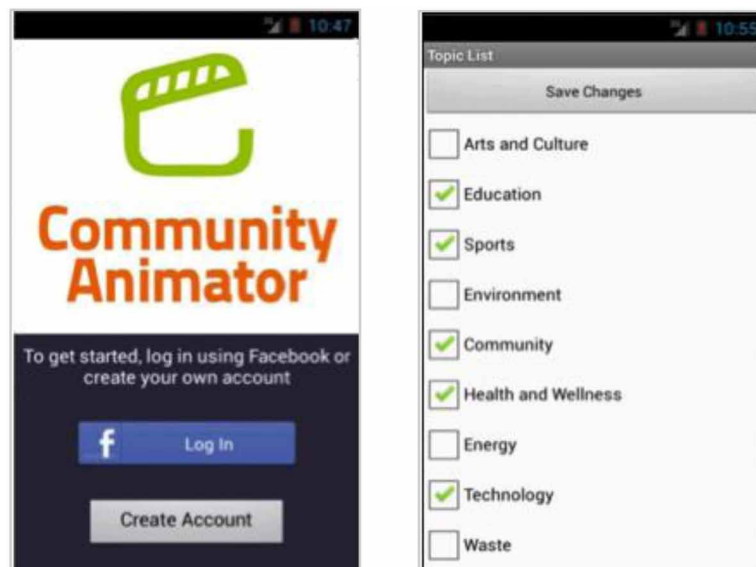
Community Animator (Figure 6) introduces new opportunities for social interaction by allowing individuals to self-characterize their community interests and activities, and indicates through an opt-in dialog that they are available for face-to-face chatting (Carroll, Kropczynski & Han, 2014). Users who choose to opt-in are matched by a combination of current physical proximity and shared community interests.

Although this application is still in development, the following scenario illustrates how Community Animator might be used:

John attends a public meeting about changes to a local housing ordinance and did not feel knowledgeable enough to provide public comment at the meeting. After the meeting, he leaves the municipal building and walks to a coffee shop across the street. He is motivated to continue talking about the ordinance and gain perspective of how the changes will affect others in the community, but as he looks around the shop, others are sitting with laptops wearing headphones or appear to be intent on cell phones and tablets.

John logs into Community Animator and selects the topic of housing. He is then introduced to someone sitting in the back of the coffee shop that is interested in the same topic and is open to conversation even though he previously gave the appearance of looking busy. John then spends his lunch sharing what he

Figure 6. Screenshots of Community Animator: A list of community issues (right) is used to characterize one's interests in order to initiate discussions with other residents while in public places



just learned at the public meeting with another community member, and their shared understanding of the changes reveal that the ordinance may be more harmful to the community than helpful. At the next public meeting that John attends, he is able to provide a more descriptive account of how these changes may adversely impact others.

Future research on Community Animator will explore mechanisms for preserving conversations in a low-effort manner, so that important community discussions can be shared with a wider audience. This initial work will simply work to identify how these community interactions can create shared trust, collaborations, and a “win-win” culture for divergent or siloed groups. The results of this project will provide information that is useful to both researchers and community practitioners. Using geo-location data of where the mobile application is accessed, we will be able to identify and celebrate community buildings that are most often used as third places by community members.

Informed discussion among citizens is essential to democracy. Broad participation in civic discussion is both more feasible and more important for democracy in community scale. People are more engaged in communities when they feel that their participation can make a difference, and conversely. Local government and local civic deliberation have always been place-based; typical issues are planning and zoning of neighborhoods, commercial districts or other functional regions within a town, development and maintenance of services and infrastructure that is placed, like roads, sewage lines, parks, buildings, and so forth. It is already the case that interactions in the public sphere now are often carried out online through websites, forums, and emails.

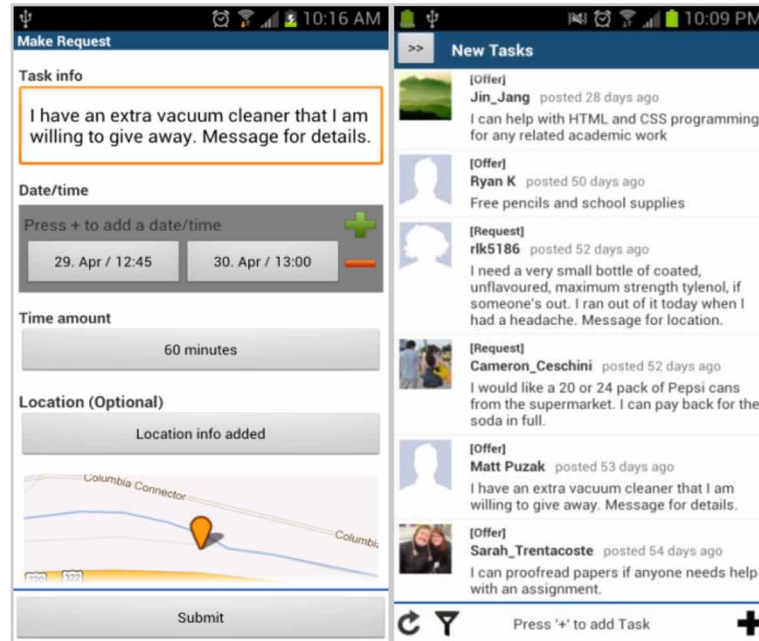
Community Animator provides a new way to encounter fellow community members, participate in the local community, and act on collective impulses. A related example is Mobile Timebanking. Timebanking is a community exchange system where people contribute services to the community valued on the basis of the time it takes to perform the service (Cahn, 2000). The person who provided the service is entitled to receive that amount of services from members the timebank. This is strongly equitable basis for exchange, and has been found to strengthen communities, as well as to enhance personal efficacy and self-esteem (Seyfang, 2004; Shih, Bellotti, Han & Carroll, 2014).

Mobile Timebanking moves the timebanking interactions to a smartphone platform; by tying the interactions to a specific time and place, participants have the opportunity to make more fine-grained exchanges. Consider possible scenarios such as “My son left his history book at school today (Mr. Smith’s room); if you are picking a child up could you get it for me?” or “I forgot to get milk on the way home; if you are stopping at the local grocery store, could you get me a ½ gallon of 2%?” Supporting timebanking activities with a mobile application allows these exchanges to address time and place-dependent needs and interests (Han, Shih, Bellotti & Carroll, 2015). Such requests can be seen as possible future place-based events; actually, each has two local place references: the place where someone needs a service (the school, the grocery store), and the person’s current location (waiting for the service).

We are currently exploring the opportunities and potential benefits of mobile timebanking. We have designed a mobile timebanking application that supports core functionalities such as posting or accepting tasks or services, reporting completed tasks, giving time credits, and viewing a task history or a user’s profile details (Figure 7). To take advantage of smartphone capabilities, the application has been also designed to support more functionalities that are suited well in mobile computing such as having a map view that shows both user’s location and task locations posted by other local residents as well as providing a notification feature which allows users to receive a notification for any incoming text messages from others or status updates of the tasks in near-real time at any locations.

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Figure 7. Screenshots of Mobile Timebanking for community volunteer exchanges: Add a task page (left) and a list of tasks requested and offered by participants (right)



In a five-week field trial, mobile timebanking was easily adopted and clearly leveraged the affordances of mobility (Han et al., 2015). During the trial, participants were able to add geo-coordinates to tasks they posted, which allowed others to access tasks based on their location, and in some cases was a specific inducement to accept a task request. This mobile timebanking app is now incorporated into the hOurworld timebanking group, with more than 400 affiliated local timebanks and 28,000 members as of February 2015. There exist great research opportunities to understand how timebanking members utilize mobile technology in exchanging timebank services and articulate the benefits and challenges of mobile timebanking in the near future.

Places Are Governed

IoP raises possibilities for cultivating democracy at the level of individuals, which is through the informal, public practices that de Tocqueville (2003) called “habits of the heart”. Thrift (2004) argues that affect and political discourses and their formation should be treated as an integrative part of a city rather than a separate process apart from the city’s infrastructure. IoP also presents new affordances for local government. Korn, Matthias and Back (2012) found that places can encourage expression and communication of memories, feelings, and attitudes, and that sharing emotions in this way may promote civic discussions relating to geographic areas in neighborhoods or communities. Indeed, Lost State College was inspired by a design concept first described by a local town official, and the Historic Resources Commission, an agency of the municipal government, provided much of the non-social content presented.

Communities as places are fundamental social units where members have keen interest in taking collective actions and addressing the conflicts arise from the multiplicity of practices, beliefs, and needs. Place-based communities form the bedrock of a democratic society: to be a high-functioning social unit, political participation and civic engagement must be practiced at all levels of public decisions – whether economic development, standards for community behavior, maintenance of shared infrastructure, or law enforcement. Democratic governments depend on the engagement and participation of their members, and IoP can aid governance by improving participation and engagement in local political discussions and decision-making.

An important positive attribute of community is that the members cooperate; healthy communities practice sustained care and concern for one's fellows (Yuan, 2002). Cooperation in turn presupposes effective communication. Often a community is small in number, perhaps comprised of people living in close physical proximity, as in a neighborhood, village, or town. Such communities find it easier to engage in participatory and deliberative democracy, due to physical proximity to others and the likelihood of sharing of common experiences and perspectives through encounters and conversations. Democracy in local communities can be a lived-in experience, and the desirable conditions of democratic practice tend to be found in the social relations of the local community (Smith & Blanc, 1997). There is ample evidence that community-based action has occurred in a wide variety of cultures and is universal (Castells, 1983)

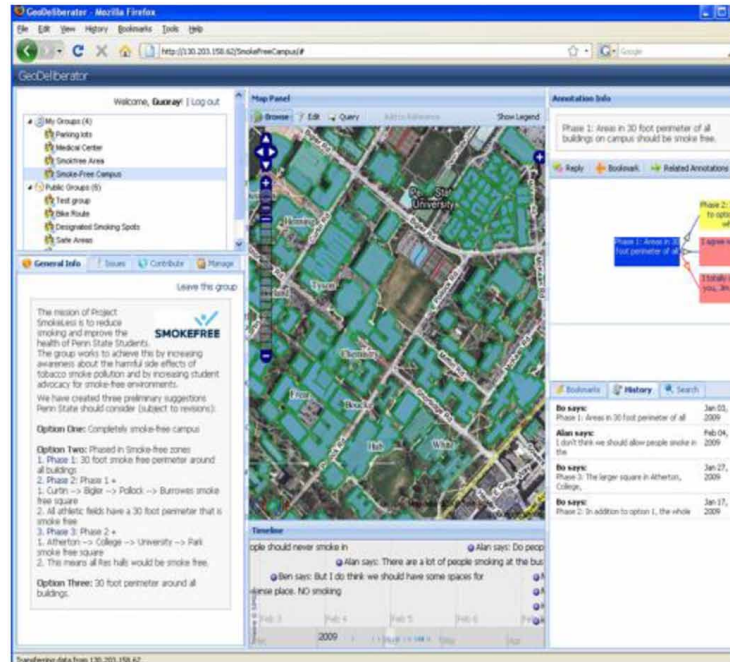
In cases where close proximity is not possible, or informal personal interaction is not typical, social media and geospatial technologies may help to support the communication and sharing needed for joint action. However, the simple provision of such tools is not always enough, for example when topics and opinions depend inherently on the spatial structures and relationships within a community (e.g., a set of streets, intersections or buildings). In such cases a democratic community may benefit from a more elaborate integration of the shared concerns with the associated places.

To explore this possibility, we are developing the GeoDeliberator (Cai & Yu, 2009; Kropczynski, Cai & Carroll, 2015), an online tool for place-based deliberation. Figure 8 shows a prototype of the tool that introduces spatial language concepts into deliberative dialogues offered to community members. The tool incorporates techniques such as geotagging, geoannotating, and geovisualization to meet its design goals. Using the GeoDeliberator, a community can organize multiple parallel deliberation forums, where each forum presents a unique mission or issue to be examined collectively by the participants. Forum members can view a set of relevant documents together, and can also identify, annotate, and question the information nuggets. The forum information and community conversations can be accessed through geospatial, timeline, and conversational thread views, providing multiple overlapping perspectives on the same set of issues. The tool is designed to enable considered opinions to be expressed, contrasted and synthesized as collective opinions consistent with the principles of deliberative democracy.

A related system is the Future State College project, designed to engage residents in discussion of master plan frameworks that municipal governments develop to guide local development over the long term (10-15 years). A master plan includes many detailed sketches and other images of future streetscapes. Our partners in the city government told us that citizens often have difficulty understanding the plans and seeing the future environments in context, and that this is an obstacle to more effective participation in local government planning processes. We worked with the government of State College, Pennsylvania, to organize documents and imagery from their planning process and make them available through a mobile application. Thus, analogously to Lost State College, a resident can examine representations of the future plan for particular locations in the town while visiting and experiencing those places (Figure 8).

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Figure 8. GeoDeliberator's User Interface: (1) Group Panel, (2) General Panel, (3) Map Panel, (4) Timeline view, (5) Annotation info Panel

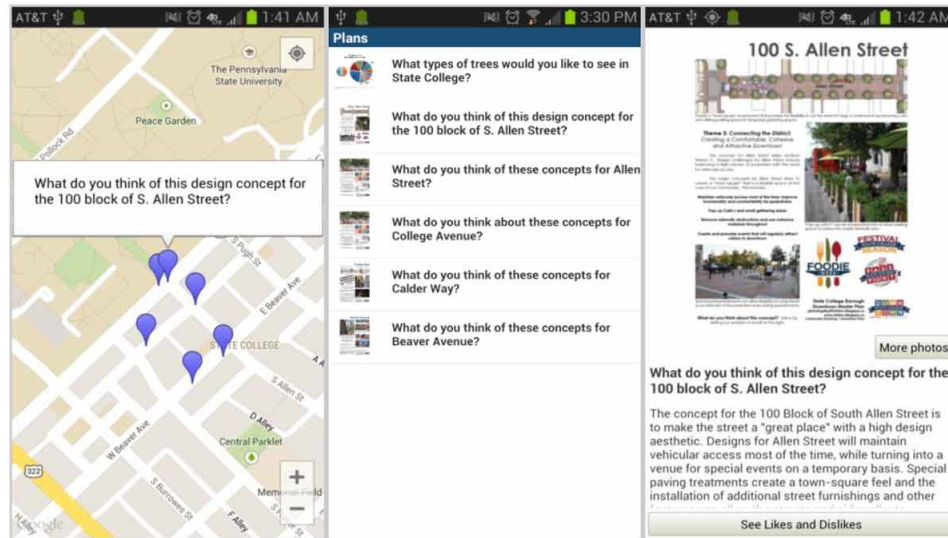


We are now designing the mobile application called Future State College, which has a similar rationale of Lost State College with respect to increasing civic awareness and participation but using different content (Figure 9). We are striving to give local citizens easy access to the master plan, specifically the parts of the plan tied to their current location. Our municipal partners hope to collect feedback and comments from local citizens and see their reactions and thoughts in a simple and integrated fashion, which could also be considered and discussed in planning processes. In this sense, we have implemented a simple voting and comment interface to the application. More specifically, citizens can up-vote or down-vote on the plan, add their own comments or read others, and like or dislike others' comments.

The simple and easy-to-use Future State College application will benefit both citizens and the municipal government. From a citizen's perspective, it will be easier to stay aware of future plans and express and share thoughts with other citizens as well as the government. From the government perspective, officials will be able to see how their constituents think about the plans both in general (the up- and down-votes) and more specifically (their more detailed comments). The Future State College application is another example of making place-based local community information and interactions more visible and accessible through mobile technology.

Overall, IoP allows us to directly integrate civic behavior with the community places to which the behavior refers. IoP can involve the posting of official information maintained by the municipal government (including requests for public comment), but it could also include the sharing of informal and ad hoc thought and experiences of citizens (Here & Now), historical context about places and their surrounding locales (Lost State College), local events and volunteering tasks or services that are occurred at or are scheduled to occur at a place (Arts Festival and Mobile Timebanking), face-to-face conversations about

Figure 9. Screenshots of Future State College: A map view with the plans presented as pushpins (left), a list of the plans (mid), and a detailed view of the plan (right)



local issues in third places (Community Animator), online community discourse for local news, events, and activities (Local News Chatter), and local future plans tied to different places (Future State College).

Once a place is regarded as a container for digital content, it invites related content, for example comments or discussions contributed by people who visit the online place. A person having coffee downtown might browse and even contribute to a debate about road construction that is causing traffic jams outside the window (Carroll & Rosson, 2008). This kind of scenario further integrates and leverages hyperlocal information and interactions while also potentially making local civic deliberation more sensitive to actual users and experiences of community services and infrastructures.

The use of community places to organize community events and activity, including civic deliberation, is a proactive application of IoP. The mobile applications we have described enhance awareness of and interest in community places, reinforcing both community identity and willingness to participate, two of the defining principles of community itself (Cahn, 2000; Carroll & Rosson, 2013).

DISCUSSION

Although Internet technologies have richly interconnected our world, they are only now becoming integrated with that world – in the Internet of Things. Much of daily life is still lived within geographic locales – in place-based communities. Information and interaction challenges in community-scale are distinctive and critical: Local community information, examined source-by-source, is sparse in many communities. Local newspapers, nonprofit groups, businesses, bloggers and forums each generate relatively few local news items, posts, etc. in comparison with national news and entertainment feeds. Analogously, local community interactions online, examined site-by-site or service-by-service, often fail to exceed the threshold of community perception, because there tend to exist few posts and even fewer comments in online local space.

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IoP at a community scale is more than a corollary of the IoT plus GPS technologies. It is the project of leveraging better hyperlocal participation in and access to the meanings, activities, and emotions of community places. This is not an inevitable given of information technology in general, or of the IoT in particular. Rather, it is a critical alternative toward which we can orient and progress.

We have presented a set of prototypes, interaction scenarios, systems, design analyses, and empirical studies. These prototypes illustrate possibilities for aggregating and presenting the feelings people have about the places they live in. Here & Now makes visible the beautiful but mundane experiences of everyday life. It integrates Hester's concept of sacred places with the flow of lived experience, raising the possibility that the sacred structure of a community is dynamic, and constantly negotiated through life experiences.

Indeed, Lost State College illustrates how part of a community's sacred structure is being constructed constantly through the experiences and activity of people. This application juxtaposes the past and present of sacred places throughout the community, and invites people to experience and share. History is remade every day, because the present is the reference point, and is always changing. This is easy to miss when the history of most sacred places is masked by the present, and not embodied with it.

The IoP at community scale enriches community activity by connecting people to feelings, opinions, and events, and to other people. For example, Local News Chatter aggregates information sources in a new way, to emphasize the connection between a local public event or topic, something that might have been described in mass media, and the personal reactions and insights neighbors have to that event or topic. It connects people to the experiences of the community, and directly to others, people whom they may yet not know or know well.

Mobile Timebanking and Community Animator are examples of new kinds of community interactions enabled by IoP. Mobile Timebanking enhances awareness of opportunities to help and to be helped by nearby others as one moves through the community. Making needs, interests and abilities more visible, and matching them on the fly, could mutually leverage resources and opportunities. It could change the modern experience of being out in public toward less anonymity, more engagement, and the constant possibility of meaningful happenstance. Similarly, Community Animator allows people to make themselves available for discussions about community themes and projects. This concept can make any public place into what Oldenburg (1989) called "a third place", where citizens engage on an equal footing.

Beyond personal and informal place-based experiences and interactions, the IoP should facilitate and enrich public life. The GeoDeliberator presents local citizens an online forum to debate about public policy choices, facilitated by a spatial perspective (through maps and visualizations) on facts and analysis drawn from public policy documents, and statements by subject-matter experts. This project also emphasizes the value that citizens can provide to such discussions by creating paths and summaries of investigation on issues in a way their fellow citizens could use. One premise is that complexity of information spaces, even for municipal issues, is complex and poorly organized, and that citizens do not know where to begin or what to do to make a difference.

Another example of how IoP at community scale can address the public sphere is Future State College. Citizens can view and comment on various depictions of the future plans for a local place, which physically visiting that place to help image the consequences of planned developments. The premise of this prototype is that by embedding the plans in concrete contexts of community places will make the plans more understandable, and more interesting to citizens.

As is often the case, the primary purpose of design prototypes is to evoke further ideas and better ideas. In that sense, this set of prototypes is not an answer to the question of the IoP at community scale, but rather move us a step toward better framing the question.

IMPLICATIONS

Socio-technical innovations always have both direct and indirect effects. Direct effects are shorter term, and often intended. Indirect effects often take more time to become apparent, and are frequently unintended consequences. As described, the direct effects of the Internet of Places at community scale are place-based experiences and interactions that are socially and emotionally richer, more meaningful, and perhaps more effective for the people who live together in a place and increasing the sense of place attachment (Lewicka, 2011).

Considered as a critical alternative, the IoP at community scale also might entail broader, longer-term, and less direct socio-technical consequences. One such consequence might be that newcomers could more easily come to know a neighborhood or town they moved into, both its places and the experiences, interactions and activities that give those places their meaning. This is most basically a learning and access implication: Visitors and newcomers might be able to learn much more about communities through visiting their places. Marginalized and peripheral members of a community might more easily move toward the center. Public backtalk about public places might ameliorate one of the least attractive consequences of close, place-based community, namely, that of insider versus outsider. If it were easier to understanding what is going on in a community, what places mean to the members of the community, what events takes place and with what significance, etc. then it might be much easier to become a member of the community, and to more easily pass from the outside to the inside.

Another consequence might be enhanced mindfulness. Enriching various places with signature experience, memories, issues and discussions, and plans for the future would make it harder to turn off attention, to be inert as to where one is. The broadest way to view this is as affording a more mindful human experience, a way of living in which one is more aware of one's own thoughts and feelings moment-by-moment, more aware of others, and just awake to life. More narrowly, IoP might at least make us specifically more mindful of our own neighbors, neighborhoods, and communities, more aware of the now-invisible personal narratives and currents of emotion that constitute our local places.

Of course, as cities and communities are becoming more technologically-enhanced, there are numerous privacy implications when sharing personally-identifiable information that could lead to untended consequences. Misleading, false, or biased information may perpetrate escalation of public hysteria and social bubbles that may be difficult to overcome. There is also the potential of over-sharing, and it might be that people need the down time of relative anonymity and isolation, and that places sharing feelings, reminding us of community heritage, and updating us on local news, opinion, and issues would overwhelm us.

We are optimistic about the potential upsides of enhancing access to and engagement in local places for increasing participation in local community matters. In all of our projects we have encountered great interest in knowing more and sharing more. In many cases, community members don't know how, when or where to start, and often vastly underestimate how much they already know and can contribute even though the opportunities are literally all around them (Carroll, 2012; Carroll & Rosson, 2013). In our case studies, we anchor community history, news, events, interests, and discussions to geospatial maps

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that are open for participation among local community members and external visitors. IoP creates digital third places of discussions that could connect citizens with shared interests and further strengthening community identity, membership, and presence (Carroll, Shih, Hoffman, Wang & Han, 2014), and this is evident in almost all of the case studies (e.g., Community Animator, Local News Chatter, Community Poll, Lost State College, Future State College, etc.).

The Berkeley Community Memory was the starting point of a sociotechnical movement eventually called community networking (Schuler, 1996). In information technology, we confront new challenges and opportunities regularly; each is a possible new starting point. In this paper we described our investigation of an extension and specialization of the Internet of Things, one we call the Internet of Places at community scale, as an initiative in community networking in the long thread of research and development inspired by the Berkeley Community Memory.

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