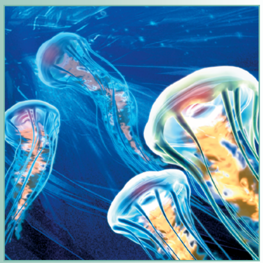
Social Networking



P3 Systems: Putting the Place Back into Social Networks

We can now use a range of technologies to locate individuals as they go about their daily activities. The availability of such technologies enables a new class of location-aware information systems that link people-to-people-to-geographical-places (P3 systems). P3 systems can strengthen the relationship between social networks and physical places. They can also help individuals leverage location information to make new social ties and coordinate interactions that reinforce existing ties. Using their P3 systems framework, the authors describe the design space for location-aware community systems and important socio-technical challenges and opportunities.

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Improvements in communication and transportation technology have shifted community ties from primarily people-to-people-in-geographical-places to people-to-people irrespective of local geography.[1] As a result, people in residential areas and urban work environments often have only limited interaction with their geographic neighbors, whereas they are in regular contact with other, geographically dispersed individuals. These changes lead many scholars to fear that rapid modernization, through the weakening of place-linked social relations, could cause a loss of community.

Researching this notion of loss of community led to modern social network analysis, a conceptual revolution in defining the term community in terms of social networks, and an understanding that individuals can use technology to maintain a network of strong social ties with kin, friends, and colleagues who don't necessarily live in the same neighborhoods. Technologists have put significant effort into freeing interpersonal interactions from geographic constraints and enabling communication anywhere, anytime. Nonetheless, communication between individuals within local geographical contexts, such as on a physical university campus or local community, is often desirable.

Until recently, our ability to use technology to seamlessly locate individuals and provide them with geographically contextualized personal information was limited. However, this situation is changing with the availability of a range of technologies for systematically locating

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Table 1. P3 system framework techniques summary.

Design techniques		Synchronous communication or location awareness	Asynchronous communication or location awareness
People-centered	Absolute user location	Uses remote awareness of current user locations	Uses people's location histories
	Collocation/proximity	Uses real-time user collocation	Uses collocation history to exchange social information.
Place-centered	Use of physical places	Uses online representation of user's current use of physical spaces	Uses history of people's use of a particular space
	Matching virtual places	Uses synchronous online interaction spaces related to physical location	Uses asynchronous online places interactions related to physical location

Table 2. Representative P3 systems and techniques.

Design techniques		Synchronous communication or location awareness	Asynchronous communication or location awareness
People-centered	Absolute user location	Ulocate: user real-time tracking	Ulocate: user location histories
	Collocation/proximity	LoveGety: proximity match alerts	Social Net: social match alerts inferred from collocation histories
Place-centered	Use of physical places	ActiveCampus: maps showing location of users on campus	FolkMusic: maps overlayed with in situ user music listening histories
	Matching virtual places	MOOsburg: chat for real-time discourse in matching virtual places	ActiveCampus: graffiti system for digitally annotating physical locations

individuals as they go about their daily activities. A prominent example is the increasing use of the cell phone as a locating device, encouraged by commercial opportunities and legislation (such as the US Federal Communiations Commission E911 mandate requiring the deployment of a location-based services infrastructure). Using such technologies, we can combine computer-mediated communication and location data to provide appropriate geographic context to person-to-person interactions. Various proof-of-concept and commercial systems are now available, some of which enable individuals and groups to associate text notes with locations. Others have provided users with an interface that provides awareness in terms of the location and availability of buddies as means to increase informal interactions. These developments show how the emerging technology environment raises the opportunity for a new class of information systems that connect people-to-people-to-geographical-place (P3 systems).

The advent of P3 systems is of considerable social importance because we can potentially use them to strengthen communities by helping individuals leverage location information to meet new people; turn acquaintances into friends; and better coordinate interactions with family, colleagues, and friends. In so doing, P3 systems can help maintain and expand geographically concentrated *social capital*[2] — the network ties of goodwill, mutual support, shared norms, social trust, and a sense of mutual obligation from which people can derive value within a geographical area. Keeping all this in mind, we present the P3 systems conceptual framework,[3] which aims to systematically characterize the design space of location-aware community systems, identify key challenges, and suggest important research opportunities.

Conceptual Framework

There are a growing number of P3 systems and a diversity of approaches. To provide the area with a firmer foundation, we developed the P3 systems conceptual framework from an analysis of deployed P3 systems and associated research. The framework organizes the design space of location-aware community systems into a 2×2 matrix of different types of system techniques (see Tables 1 and 2).

The rows of the framework characterize the user interface, which we divide into two main types:

- *People-centered* techniques use location infor-

Wizardry or Technology

We can contrast place- and people-centered P3 system techniques by comparing two of the magical tools J.K. Rowling describes in her Harry Potter books. The Weasley clock is an example of a system based on a people-centered technique:

> [The clock] was completely useless if you wanted to know the time, but otherwise very informative. It had nine golden hands, and each of them was engraved with one of the Weasley family's names. There were no numerals around the face, but descriptions of where each family member might be. "Home," "school," and "work" were there, but there was also "traveling," "lost," "hospital," "prison," and, in the position where the number twelve would be on a normal clock, "mortal peril."[1]

The Marauder's Map is a P3 system based on a place-centered technique:

> It was a map showing every detail of the Hogwarts castle and grounds. But the truly remarkable things were the tiny ink dots moving around it, each labeled with a name in minuscule writing. Astounded, Harry bent over it. A labeled dot in the top left corner showed that Professor Dumbledore was pacing his study; the caretaker's cat, Mrs. Norris, was prowling the second floor; and Peeves the Poltergeist was currently bouncing around the trophy room.[2]

Although the Weasley clock user interface provides rich information about the activities of the Weasley family, it provides limited information about activities in particular places. Similarly, the Marauder's Map provides users with an understanding of activities at Hogwarts but is useless at tasks such as tracking individuals through a wide variety of environments.

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1. J.K. Rowling, *Harry Potter and the Goblet of Fire,* Scholastic Press, 2000, p. 151.
2. J.K. Rowling, *Harry Potter and the Prisoner of Azkaban*, Scholastic Press, 1999, pp.192–193.

mation to support interpersonal awareness, enable communication, and identify previously unknown affinities between users.

- *Place-centered* techniques link virtual spaces to physical locations, using social information to aid place-based navigation and decision making.

The distinction between people- and place-centered techniques is nicely illustrated by contrasting two examples of magical P3 systems from J.K. Rowling's Harry Potter series. (See the "Wizardry or Technology" sidebar for specific details).

The columns in Tables 1 and 2 show the computer-mediated communication research community's traditional distinction between synchronous and asynchronous systems. This distinction, however, extends beyond communication to include user-location information — namely, synchronous and asynchronous location awareness. This distinguishes techniques that provide information about current user location or activity within a place from those that provide historical information.

Table 2 shows how some of the currently available system implementations of design techniques fit into our conceptual framework. Table 2 highlights how a single system might implement different types of P3 system design techniques; however, for ease of exposition we refer to systems, rather than techniques, when the context makes the meaning clear.

We further subcategorize people-centered techniques into those that represent absolute user location and those that operate in terms of user proximity or collocation. The distinction here is between techniques that tell you where your "buddies" are versus those that can tell you only which buddies are close to you now. For example, the Ulocate (www.Ulocate.com) application represents absolute user location by tracking the current location or location history for a specified cell phone user, and LoveGety[4] uses physically collocated individuals' profiles for social matching. Social Net[5] uses proximity to infer people's affinities from recurring collocation patterns.

We subcategorize place-centered techniques into those that represent use of physical place by users and those that enable people-to-people communication through virtual places superimposed over the physical world. An example of the synchronous use of physical places technique is the ActiveCampus Explorer's[6] Maps interface, which overlays campus maps with avatars that represent current locations of buddies and other users. In this way, system users can see how crowded a location is. An example of the asynchronous use of physical places technique is provided by the FolkMusic[7] system, which represents the music associated with various locations through an analysis of users' geotemporal music-listening histories. MOOsburg,[8] a community network system for Blacksburg, Virginia, provides various tools including an interactive map that users can pan or zoom to locate and navigate to virtual representations of geographical places and a related chat area for various locations that are representative of synchronous use of the matching virtual places technique. ActiveCampus Explorer also uses the matching virtual places design technique through its place-linked digital graffiti interface, which lets users annotate the physical world by creating location-linked electronic notes on campus maps.

P3 System Framework Utility

Information systems that systematically link people-to-people-to-geographic-place have only recently been recognized as a distinct class of applications. Yet, doing so lets us distinguish between basic design features, which in turn helps us understand the relationship between design approaches and such key socio-technical challenges as implementing appropriate privacy management, socially sensitive place-linked recommender systems, and effective geotemporal social matching.

Privacy concerns

Many researchers have explored privacy and security issues in collaborative and ubiquitous computing systems. The P3 systems framework can help us identify the privacy concerns associated with the various techniques used in location-aware community systems:

- For *absolute user location* techniques, the key issue of concern is the possibility of "stalking" or simple violations of users' desire for privacy. In fact, users consider absolute user location techniques more problematic than alternate approaches.[9] This suggests that using this technique makes sense only in the context of strong social ties between users, a clearly defined work setting or task, or law-enforcement situations.
- For *collocation proximity* techniques, the key concerns are associated with geotemporal social matching, which is the leveraging of location data to bring people together for interaction and potentially new relationships. In systems that synchronously match people based on user profiles, there is the issue of information overload and identity management. For example, do attractive-looking individuals waiting for a train want to be inundated with notifications to meet strangers or have fellow passengers identify them without some sort of input? It's vital that systems provide trustworthy tools so that users can safely and progressively reveal their personal identity data. Other issues arise when asynchronous processing is added to the mix. Consider a system, deployed within an organization, that records when people are in proximity. Such a system could analyze collocation data to identify ad hoc work groups; this information might in turn be useful for organizational planning and the allocation of resources. However, the same data and the same type of analysis might inappropriately reveal a budding office romance.
- *Uses of physical places* techniques don't necessarily raise as many privacy concerns as people-centered techniques because they often require only anonymous data about physical activities in a given place. Simply knowing that a restaurant or theater is crowded is useful, for example, even without knowing who is there. Of course, users might want to know the identities of people in a place, but enabling such features raises the same concerns we considered for people-centered systems. However, there are ways in which these concerns can be addressed. For instance, places usually have owners and fairly clear social norms that include privacy expectations.
- The *interactions in matching virtual places* techniques raise privacy issues similar to those of other, more traditional forms of computer-mediated communication systems (such as Web boards, email, and online chat rooms). An important issue here is data ownership: do the owners of physical places have any legal rights over matching virtual spaces and the private data of users in such spaces? For example, a church or school might wish to ensure that users' language in its online space is appropriate. Alternatively, faculty at a university might be able to see different digital graffiti in a classroom than the students.

This breakdown of privacy concerns in relation to the rows in the P3 systems framework highlights just how important it is to simultaneously take into account both people-to-place and people-to-people relationships when designing P3 systems. (The qualitative studies we have conducted support these findings.[10]) Currently, most social-network systems take a fairly unidimensional approach to such issues. For example, many social network applications consider peoples' relationships only in terms of broad social categories such as friends, family, and colleagues. However, people in their everyday interactions simultaneously bring into play knowledge of the multiple attributes of individuals and physical locations. For example, a person might go to a particular location at work because she knows that is where several Israeli engineers with personal knowledge of the Israeli semiconductor industry hang out and chat with other engineers. This ties in strongly with notions of place, which are generally related to particular classes of activities and have associated social norms of behavior. Furthermore, particular individuals typically play recognized roles in each place (for example, a shopkeeper, customer, student, or teacher). This understanding of place and associated social relationships helps people navigate through and communicate around physical spaces.

To effectively address P3 system usability and privacy-management concerns, we must take into account the basic relationships between people and places. To illustrate, consider the following scenario (based on a similar scenario in related literature[2]) in which Brad, a university student, has a P3 system that has idealized awareness of multiple attributes of places and people, enabling both system utility and acceptable privacy management:

> On Sunday, Brad wakes up at his parents' home and spends most of the day there. The P3 system privacy rules here specify that family members can see (remotely) who is at home but nobody else can. By default, Brad's rules for disclosing his location outside of his work and study hours are that a small group of friends can know what city he is in. When he steps out to the local supermarket, the proximity matching rules of the supermarket place-type result in his mobile phone alerting him that an unidentified friend is nearby, and it gives him the option of revealing his identity. He does, and ends up talking briefly to an old high school friend, who is home for the weekend from an out-of-state college. On Monday morning, Brad heads for his university. Unfortunately, having overslept, he's late for a scheduled meeting with his research group of a professor and two other students. Because of the team members' social ties to him and to a shared place (their research lab), they receive a notification that Brad's travel path suggests he will be 15 minutes late. Once Brad reaches campus, the campus rules take effect, making the fact that he is on campus available to other university students, faculty, and staff while keeping him invisible to any other users who are not directly connected to his student activities on campus.

Brad's scenario shows how important it is for P3 systems' privacy management to simultaneously take into account the following four factors:

- *People properties* are individual users' attributes and properties, including general attitudes as well as interests and current dispositions.
- *Place properties* include place-type (such as restaurant or classroom), who frequents the location in question, social norms concerning people's expected behaviors in that place, and so on.
- *People–place relationships* include users' familiarity with a given place and details such as whether they have distinct roles in this location (a student versus a teacher in a classroom or a customer versus a waiter in a restaurant, for example).
- *People–people relationships* (often understood in terms of social networks) include whether users already know each other, have mutual acquaintances, belong to the same organizations, and so forth.

Of course, Brad's scenario also shows how the four factors all play an important role in providing meaningful P3 systems services. In fact, as the "Location-Based Services and Localized Information" sidebar explains, effectively providing location-based services in general requires customization that accounts for properities of both people and places.

P3 Recommender Systems

Recommender systems use knowledge of user preferences and item properties to identify what users are likely to enjoy. A P3 recommender system represents and reasons with user preferences — either inferred from use or stated explicitly — about both places and people's activities. For example, a system could infer users' preferences for particular types of cuisine from the restaurants they frequent and use this information to recommend restaurants when they travel. Similarly, the system might recommend natural foods restaurants to users that regularly visit organic markets. We can extend this further by using collaborative techniques to derive P3 recommendations. For example, a system might base restaurant recommendations on a combination of a user's personal and community dining

Location-Based Services and Localized Information

Location-based services, which provide mobile-device users with personalized services tailored to their locations, are becoming increasingly important to the telecommunications industry. The development of such services has highlighted the importance of identifying geographically localized information. Table A[1] provides binary classifications of time and space resolution and suggests one type of information that fits into each of four categories.

Table A. Binary classification of time and space resolution for information.

	Geographically localized	Geographically independent
Localized in time	Traffic reports	Share prices
Time independent	Restaurant locations	Music recordings

Our work building on research in environmental psychology suggests that people identify distinct place-types (distinguished by activities in, and their relationships to, the places) and place-related information. Furthermore, the desire for geographically localized information is based not simply on place-types but also on the activity performed in a given place, the frequency with which the individual completes that activity there, and the stability of the geographically localized information in question. These factors interact because people tend to become familiar with the stable information relevant to activities they perform often in a given place. For example, a commuter will know that rush-hour trains leave every 10 minutes starting at 5:37 a.m. Given that the train schedule changes infrequently, commuters don't need to consult it very often once they learn it. In contrast, even stable information is useful when you're unfamiliar with a location — tourists must constantly consult maps, for example, even though the streets don't change. Table B describes this relationship and shows the interaction between information type and the frequency of doing an activity in a place.

Table B. Frequency of activities in places and the stability of geographically localized information.

	Stable information	Dynamic information
Activity done in a place frequently	Need: Low Commuter: What is the train schedule?	Need: Moderate/high Commuter: Is the 10:17 a.m. train on time today?
Activity done in a place Infrequently	Need: Moderate/high Anyone: How do I get to a restaurant that I rarely visit?	Need: High Anyone: What movies are playing this afternoon at a theater I don't go to often?

We can see from this discussion that geographically localized information needs relative to a place depend on the activity that individuals are doing there (sitting at versus managing a café, for example), how frequently they do those activities, and the nature of the information in question.

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1. D.J. Goodman, "The Wireless Internet: Promises and Challenges," *Computer*, vol. 33, no. 7, 2000, pp. 36–41.

routines, which can be obtained from analyzing absolute user-location data histories. Proximity data help to identify collocated groups and to then recommend activities of shared interest. P3 recommender algorithms could also profit from accounting for a location's current status. In addition to considering a restaurant's overall quality and users' culinary tastes, for example, the system might base its recommendations on the wait time for a table and the ambient noise level. When virtual spaces are associated with physical places, a common use is to let users enter ratings and express opinions, which place-based recommender systems could use in turn. A significant challenge (and opportunity) is to develop recommendation algorithms that combine these diverse types of implicit and explicit user preferences and place information using the P3 systems framework. We see this opportunity as more than simply a way to improve users' navigation of physical space — rather it is technology that's likely to have major social implications.

Advances in technology have dramatically reduced participation in traditional voluntary associations such as social clubs, professional societies, and religious institutions.[2] Instead, people are increasingly using both networked and mobile technologies to navigate and form communities in a complex mix of physical and virtual social spaces. Unfortunately, this approach is severely limited by current system designs, which fail to systematically use the dynamic combination of information about people, places (real and virtual), and organizations. Consequently, people often fail to find appropriate interaction environments, and organizations often fail to attract people to the environments they provide. For instance, organizations still have to invest considerable effort to coordinate the critical mass of individuals required to enable events and new sustained community interactions; for example, Meetup.com often fails to coordinate enough people to set up the majority of its proposed "meetups," despite having more than a million users.

We can make a strong case that only P3 recommender systems will be truly effective if they simultaneously account for interaction environment status, the needs of individuals, and the needs of organizations. Only then will they fulfill their potential to build geographically concentrated social capital. Interestingly, such P3 recommender systems, or *societal recommender systems* (matching individual, societal, and organizational needs) are likely to have more impact than the first-order effects of P3 systems, such as helping individuals meet new people, turn acquaintances into friends, and improve coordination between known individuals.

Geotemporal Social Matching

Social matching systems are recommender systems that bring people together in both physical and online spaces. They often do so by providing users with access to various aspects of other users' profiles through listings (often in the form of friend-of-friend systems, such as friendster.com) or social network visualizations. Social matching systems typically include match-alert mechanisms and introduction-management tools that aim to encourage interpersonal contact. Applications for such systems include finding others with similar social interests (www.friendster.com), business networking (www.LinkedIn.com), knowledge management (www.Tacit.com), and dating (www.eharmony.com). Social-matching profiles can change over time and be linked to computerized models of users' social networks and reputation measures.

To effectively address P3 system usability, we must take into account the basic relationships between people and places.

Geotemporal social matching systems are a class of P3 recommender systems that leverage users' geotemporal histories to match individuals. In everyday life, we often use location to find social matches without the aid of computers — for example, we find our colleagues at work, and we often meet friends at various social locations such as gyms and social clubs. Computerized systems can potentially leverage geotemporal data to support social matching. In fact, it's theoretically possible to develop social-matching algorithms that exploit, and potentially combine, each of these P3 system techniques:

- We can use stored *absolute-user-location* data to derive affinities based on similarities among users' geotemporal routines. For example, algorithms for matching location histories can search for common or nearby locations and similar paths and even take time into account — that is, it's more interesting to know that two people have been at the community soccer field at the same time than simply that they have both been there. Such algorithms would be even more effective if they learned to use information about place-types; for example, two individuals might make a good match if they were both regular churchgoers, even if they went to different churches.
- *Collocation* data is the most common trigger for geotemporal match alerts (as seen, for example, in LoveGety, Social Net, and Nokia's recent Sensor application [www.nokia.com/nokia/0,,73651,00.html]). In others words, when individuals with matching profiles come into proximity, they receive alerts suggesting that they meet. However, our discussion of privacy management suggests that we need to combine such introduction alerts with identity-revelation tools that let users meet while maintaining control of their personal data. This, in turn, suggests that collocation data will also need to be combined with use of physical places data to inform the order and timing of the personal information revealed. For example, it might be appropriate to start with the exchange of political affiliations at a political rally, but this might not be appropriate in a work setting.
- *Use of physical places* data can be used to determine the appropriateness in terms of timing and content of individual match alerts. For example, in a place with a dense and frequently changing population, such as a university

cafeteria at lunch time, the frequency of potential match alerts might need to be tempered by a higher level of specificity or user interest because of the likelihood of overloading the user. Similarly in other locations, such as a train platform late at night, match alerts might be inadvisable because of safety concerns, or in settings such as a client's office, they might not be socially acceptable.
- Users' use of *matching virtual places* for various interactions can be data mined to identify shared interests and provide a safe place for virtual, and perhaps asynchronous, introductions.

This discussion highlights how truly effective geotemporal social matching will use data associated with each of the P3 system techniques we outline in the framework. It also hints at the profound impact such systems are likely to have on our routine navigation of the physical and social world.

Desire for P3 System Services

As with any new technology, we must consider whether users actually desire the services that P3 systems could offer and if they're willing to share the necessary data. To examine the utility of a range of P3 system services, we conducted a survey at 14 different place types (such as parks and restaurants) in Manhattan.[11] Questionnaires were given out to people present at these places. We found that over 84 percent of the more than 500 respondents were willing to share their location data to obtain information about occupancy and crowding in public places; 77 percent were willing to let others know their current location in public and semipublic places (69 percent with family and friends, 32 percent with work- or service-related individuals, and 17 percent with strangers); and 54 percent were interested in reading place-related comments (interaction in matching virtual places).

The majority of respondents (57.5 percent) wanted to know information — including hobbies (22 percent), age (18.8 percent), musical preferences (12.2 percent), political opinions (12 percent), income (11 percent), ethnicity (9.8 percent), and religion (5.3 percent), — about the people that came to the survey sites. These findings suggest that a large proportion of the population considers the utility of P3 system services to be sufficiently beneficial that they would be willing to let specific services collect and use their personal geotemporal data —for example, to let people know if a place is crowded or tell a friend that they are nearby.

P3 systems have great potential and promise, not just in terms of fun new services such as finding someone nearby who is also in the mood for karaoke (a LoveGety option) but as community systems that support the creation of geographically concentrated social capital. However, we can realize P3 systems' potential only if compelling applications are developed that effectively manage associated privacy concerns with multiattribute social network and place data.

P3 systems have great potential and promise as builders of geographically concentrated social capital.

When the necessary requirements are met, we can expect social recommendation systems to have a major impact on how individuals navigate their social and physical landscapes.

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