Enhancing Urban Community Enclaves with P3-Systems

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A college campus in an urban location such as Newark, New Jersey is a semi-public place, with some areas open to the public and others locked and protected for "members only." It is an example of what might be called an "urban enclave," which is an identifiable physical area "owned" by or identified with a specific organization or purpose. The urban enclaves in which we are interested have multiple buildings or venues and a permanent or semi-permanent core of members, but also have visitors and considerable change in population over time, and are typically sized between 1,000 and 30,000 people. Other examples might be corporate office parks, and large museums. The large number of people who come and go in such urban enclaves potentially have interests in common and could use tools to discover others with similar interests, or to keep track of the presence or absence in the space of those who are already acquaintances or collaborators. We are exploring how systems that connect **P**eople-to-**P**eople-to-geographical-**P**lace, or P3-Systems, can be used to support communities in such urban enclaves.

A number of systems that link information and communication to the actual physical locations of people and places have been prototyped and made commercially viable. Recently systems like Ulocate (http://www.Ulocate.com/) have been deployed that support the tracking and use of location histories of specified users. In Japan *LoveGety* allows the swapping of simple profile information, to match and alert co-located people with similar interests. Rather than developing and studying one such application, however, we will be developing, deploying, and studying the impact of an integrated family of applications, some synchronous and some asynchronous. The suite of applications we will deploy will cover all of the basic P3-System techniques as shown in Table 1.

Table 1 Taxonomy of *SmartCampus* P3-Services

***SmartCampus* Services**		**Synchronous Communication or Synchronous Location Awareness**	**Asynchronous Communication or Asynchronous Location Awareness**
People Centric	Absolute User Location	Provide remote awareness of current user location of authorized "buddies" (research partners)	Utilizes people's location histories
	Co-location / Proximity	Real-time inter-user co-location for the exchange of social information	Utilizes co-location history to enable future interactions.
Place Centric	Use of Physical Spaces by People	Online representation of user's current use of physical spaces (e.g., is this conference room empty now?)	History of People's use of a particular space
	Interactions in Matching Virtual Places	Synchronous online interaction spaces related to physical location.	Asynchronous online interactions related to physical location.

Ideally, the emergence of P3-Systems will strengthen community by helping individuals leverage location information to: meet appropriate people and turn acquaintances into friends; and coordinate better the interactions with family, colleagues, and friends to reinforce existing social ties [1]. To achieve the first of these two goals, namely leveraging location to meet new people and to turn acquaintances into friends, system designers and developers need to: 1) understand how to capture and utilize geotemporal histories to identify social matches; 2) provide users with trustworthy face-to-face introduction tools; and 3)

understand how to provide geotemporally relevant social alerts/recommendations that do not overly interrupt the users or invade their privacy. Unfortunately our knowledge in regards to each of these key issues is lacking. We do not know how to effectively manage the capture of personal geotemporal histories from mobile networks of heterogeneous devices in order to compute social matches that take into account place types, recurring patterns of co-location, and place-linked roles. Nor do we have a basic understanding of how to effectively enable face-to-face introductions between users while simultaneously ensuring appropriate exchange and control of personal identity data: In what order should basic demographic details be exchanged between users? How is the revelation of identity data affected by situational variables such as place and time? How do we tie the revelation process to social networks in terms of reputation and trust?

We will study these key issues intensively using the New Jersey Institute of Technology's (NJIT) NSF supported SmartCampus location-aware community system test-bed. The SmartCampus test-bed will provide 500+ users (students and faculty) with heterogeneous wireless, locatable, lightweight, mobile, cost effective computing devices and deploy a variety of P3-Systems.

A key SmartCampus P3-System that will be used to support this research is CampusMesh, a location-aware geotemporal social matching and reminding application. The CampusMesh system will support the proposed research and inform the design of future instantiations of *trustworthy* P3-Systems. It will support social introductions and ongoing relationships between members of the NJIT community through social alerts and reminders (e.g., "there is a user nearby that you should meet" "Fred, whom you met before and put on you friend list, is in your vicinity", "get Joe to show you his new camera, while he is adjacent to your current location"). We anticipate that CampusMesh will encourage the formation of new friendships, support goal directed team formation, and geotemporal personal relationship management through geotemporal social matching, social network visualizations, and user diaries/scheduling. We aim to make the system trustworthy by providing users with appropriate levels of control for the revelation of their personal data to other users, especially between individuals who have had little contact with each other.

Other planned "P3" applications for SmartCampus include:
• NJIT's *ActiveCampus Explorer* [2] (modified from UCSD version), which enables map based "buddy tracking", location aware instant messaging, and digital graffiti;
• *SmartCampus* WiKi-web which provides context aware editable web pages about NJIT places, people and organizations according to location and season via an analysis of wireless access point used and DNS lookup; and
• *GeoMemory,* an in situ multi-media and location aware capture tool for mobile phones.

Privacy concerns, related concerns about the spread of biased and perhaps damaging or even libelous information, and the way in which these concerns may conflict with the desired services and convenience of others, are expected to be a major design challenge and topic of our research studies with prospective and actual users [1]. These concerns are likely to differ by role. For example, students might find it useful or amusing to have "digital graffiti" commenting on the quality of a professor's lectures stored on the digital map of the classroom in which the most recent lecture took place. A professor whose lecture has been cuttingly critiqued might consider this to be an invasion of the assumed relative privacy of the classroom and an incorrect and perhaps libelous assessment of his or her teaching. Should such digital graffiti be allowed? If so, how long should it remain? Must it be signed with the "real" name of the person creating it, which of course would have a chilling effect on perceived freedom of expression of the students? 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, a 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 [3]. 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. Planned semi-structured interviews with prospective users will help us to understand the number and nature of social ties (relationships such as room-mate vs. simply co-member of a club) that are trusted to be able to discover one's specific current location, versus the types of social relationships for which users desire only very general location information to be shared, such as whether the person is on campus now.

For collocation proximity techniques such as Campus Mesh, 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 subway on the edge of the NJIT campus want to be inundated with notifications to meet strangers or have fellow passengers be able to identify them without some sort of permission? 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 or find people a squash partner who usually visits the gym at some of the same times; this information might in turn be useful for organizational or personal planning and the allocation of resources. However, the same type of data and the same type of analysis might inappropriately reveal a budding office romance.

We plan to use a variety of research methods to explore these socio-technical issues, including:

- laboratory studies of how "strangers" engage in progressive identity revelations [4],
- semi-structured interviews exploring user attitudes towards issues related to privacy and interruptibilty,
- protocol analysis (thinking out loud") of prototype use to improve the usability of various software applications on different types of devices [5], through
- large scale field trials on the NJIT campus that will include user surveys and longitudinal monitoring of who-to-whom network traffic, to examine social issues and identify changes in social networks.

For example, we have begun conducting semi-structured interviews with representative prospective users, in which we describe applications such as Campus Mesh and provide an illustrative scenario of use, and then explore what privacy concerns they spontaneously mention, and the kinds of words they use to describe these concerns. Probes and follow-up questions will request them to specify how these concerns vary depending on the nature of the relationship with the current or prospective "buddy" and their location and activities at the time. The qualitative interviews will feed back into the design of both system features and the creation of structured questionnaires to be used in field trials. We hope in the future to study the generalizability of our findings by engaging in field trials in other urban enclaves.

To enable viable P3-Systems meaningful places need to be identified. The approach we are currently exploring is computerized prompting of users to label and share a small subset of locations identified through analysis of their personal geotemporal histories. In turn, we are testing the hypothesis that the difference between meaningful and less important places inside individual urban enclaves will relate to P3-System information seeking and sharing preferences and practices. We believe that the findings from these studies will provide significant insight into P3-System design.

Biographies:
Quentin Jones is currently an Assistant Professor in College of Computing Sciences, New Jersey Institute of Technology, after working in the HCI group AT&T Labs research. Prior to living in the United States Quentin was a Ph.D. student, educator and independent consultant in Israel. His Israeli activities included building the Israel Defense Force's first public website and exploring online mass interaction through the systematic analysis of Usenet and Email list discourse. In Australia in the early 1990s Quentin's activities resulted in the first internet based ethnic community network. Quentin's current research and teaching focus is social computing with an emphasis on the design of collaborative environments.

Starr Roxanne Hiltz is Distinguished Professor, College of Computing Sciences, New Jersey Institute of Technology. She conducts research on applications and social impacts of computer technology, publishing widely in books and in journals including JMIS, MISQ, and Communications of the ACM. Her research interests currently include Group Support Systems, Asynchronous Learning Networks, and Pervasive Computing.

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