

It takes a network to get dinner: Designing location-based systems to address local food needs

Lynn Dombrowski, Jed R. Brubaker, Sen H. Hirano, Melissa Mazmanian, Gillian R. Hayes

Department of Informatics
University of California, Irvine

{lynn.dombrowski, jed.brubaker, shirano, m.mazmanian, hayes}@uci.edu

ABSTRACT

Based on an 18-month qualitative study that included the creation and testing of design considerations and a prototype location-based information system (LBIS), this research provides empirical insight into the daily practices of a wide variety of individuals working to address food insecurity in one U.S. county. Qualitative fieldwork reveals that nonprofit organizations in the food assistance ecology engage in location-based information practices that could be enhanced by the design of a LBIS. Two practices that would benefit from a collaborative LBIS are 1) *practices of matching* in which nonprofit workers help individuals who are seeking assistance to food resources and 2) *practices of distribution* in which nonprofit workers help organizations access and deliver food resources to clients. In order to support such practices across organizations the cooperative design component of this research suggests that an LBIS should: *support the role of intermediaries* who engage in practices of matching and distribution; provide interactive mapping tools that *match resources to need*; enable organizations to *control visibility* over specific data; and *document work and impact*. This research further suggests that designers should explore the wide variety of spatial patterns that must align and overlap such that ecologies of nonprofit organizations might synergistically work together to address pressing social needs.

Author Keywords

design, food access, food insecurity, hunger, location-based technologies, nonprofit organizations, cooperative design

ACM Classification Keywords

H.5.3 Group and Organization Interfaces: Collaborative Computing.

General Terms

Design, Human Factors.

INTRODUCTION

A wide variety of organizations support delivery of food to those in need. While food service organizations and those they serve would benefit from coordination and collaboration among organizations, achieving this goal is not easy. The variety of skills, information resources, and technologies used to collect and aggregate information about clients and food resources is diffuse and highly varied. These services and programs are physically distributed across a large geographical space with each of

these programs having specific eligibility requirements that address different needs for clients. Furthermore, the overhead of connecting and coordinating efforts across organizations is significant. In a severely resource constrained environment, in which there are not enough people, computers, or food resources to meet everyone's needs, these organizations have been forced to specialize their services and limit their scope geographically. This approach results in a geographical, temporal, and human jumble that clients, volunteers, and service professionals navigate everyday. Matching food resources to those in need is a heavily location-based endeavor. Location-based information systems (LBIS) could enhance this activity and provide much needed support to the food service ecology.

In this work, we present the results of an 18-month qualitative research study in which we worked closely with a variety of nonprofit organizations focused on issues related to hunger. In the course of our empirical engagement with these organizations, two key goals emerged: first, they aim to match clients with information and services concerning existing food resources in the community; second, they attempt to infuse new food resources into the community when possible. Due to the highly location based yet fragmented nature of their work, there is a substantial opportunity for location-based information systems to assist in these goals.

In this paper, we outline findings from our qualitative study, including specific location-based information needs that staff and volunteers encounter. This overview is followed by a discussion of our cooperative design activities and design considerations for LBIS for hunger-based nonprofits that resulted from these sessions. We close with a discussion of the ways in which location-based information must be reconsidered in light of the issues that arose in our studies, in particular as part of design work for LBIS for organizations providing location dependent services.

Contributions of this work are three-fold. First, we present a set of issues that should be considered when designing location-based information systems for ecologies of nonprofit organizations oriented around an overarching social need. Second, we highlight the ways in which the need for inter-organizational support in severely resource-constrained environments impacts the design of ubicomp

systems. Third, we describe how location, time, and resources come together to create a kind of patchwork spatiality. While not a traditional static 'map,' such spatiality is essential to model and engage with interactively for a LBIS to support the hunger and food service ecosystem effectively.

RELATED WORK

This work examines and proposes design considerations for LBIS. Therefore, we situate and build off of two streams of research -- information technology and nonprofits and location-based information systems. First, we examine information technology usage in and interaction design for nonprofit organizations within Human Computer Interaction (HCI). Then, we examine prior studies of LBIS, focusing on representations of location.

Technology Use in and Design for Nonprofits

Nonprofit organizations often have several key challenges associated with using technology. Predominately, these organizations work in low-resource settings (*e.g.*, [16, 29]). This situation is often referred to as the “organizational divide.” This term suggests that disparities exist between organizations that can and cannot use technology to further their mission [13, 14, 20]. Limitations in the ability to productively engage with technological resources hinder the capacity of organizations to collaborate in service of a shared mission [25]. This literature also highlights the volatile nature of the volunteer workforce. The technical skills and expertise within a particular organization’s volunteer workforce constantly shift, thus creating the need for continual retraining [30, 32].

Organizations that serve vulnerable, marginalized populations, such as the homeless and victims of domestic violence, often work in constrained environments [7, 15, 18, 24, 33]. Typically, interaction design in these spaces seeks to amplify efforts of these service providers while balancing the needs of the nonprofit organization and its clients (*e.g.*, [15, 33]). Such work focuses on the needs of the marginalized and is helpful in revealing the unique challenges these organizations face.

Like the sites of prior research, the organizations we examined experienced varying constraints in terms of technical skills, equipment, and access to infrastructure. Thus, the literature in this space helped frame how we thought about designing for such nonprofits. In particular, we were attuned to the sensitivities between nonprofits and their clients. We add to this body of literature by presenting design considerations for location-based information systems for hunger-based nonprofits.

Location-Based Information Systems

Location has been a focal point for research in ubicomp from its beginning. Extensive work has resulted in techniques to sense and represent location. This work has typically focused on locating people and sensing their activities [5, 23], often via Wi-Fi and GPS-enabled smartphones. However, projects focused on sensing specific

items exist as well [34]. People have talked about the social importance of specific spaces [6] and developed means by which to infer social importance in addition to specific geographic location [3].

The increase of location-sensing technologies has coincided with growing body of work on privacy and location-disclosure (*e.g.*, [4, 10, 12, 27]). However, this work is predominantly focused on end-user consumer scenarios. Taking a somewhat different perspective, Troshynki *et al.* reframe traditional conceptions of privacy in location-based systems by arguing for an analysis of the shifting accountabilities location-based systems engender [28] across individuals and organizations.

In tandem with work highlighting ways in which location-information can change organizational and social practices [21], new systems and research projects are building on the increasing availability of location information to enrich user-experiences in contextually appropriate ways. This is particularly notable in the proliferation of location-based smartphone apps and mobile social media [11, 26]. This work builds on successes in detecting location by using this information to provide end-users with new experiences. What remains under-examined, in our view, is the potential of these technologies for organizations whose missions are fundamentally location-centric.

Location plays a key role in helping the hungry find food, and connecting under-utilized food sources to food distribution centers. However, the nonprofits in our study present some specific challenges to the currently predominant approaches to location. For example, the physical location of a nonprofit may be less important than its mobile food distributions sites – which only exist at certain times and places. Likewise, these food resources may only be accessible to individuals within certain geographical areas (either due to distance or eligibility requirements of a specific program). As such, in this paper we build on existing work to think not only about the ways in which location might impact social practices, but also about the role of location in aligning the need and constraints of providers and recipients.

QUALITATIVE FIELD STUDY

We used qualitative empirical and design methods to understand the challenges and opportunities facing organizations that serve people who are food insecure. Specifically, we undertook a qualitative field study, in which we performed participant observations, shadowing, and formal and informal interviewing. We then began a cooperative design phase of our research focused on the creating a location-based information system. Finally, we conducted an additional interview study to validate and refine our design considerations.

Over a period of 18-months, we conducted a qualitative field study with a diverse set of food-related nonprofits specifically focused on local food sustainability and food access for vulnerable populations. These organizations

included two food banks, two organizations assisting with food-specific programs for vulnerable populations, and one religiously affiliated organization. Organizations were located in both urban and suburban settings. Across these sites, we conducted 32 interviews and over 30 hours of observation. Interviews included questions about daily practices, technology use, and interactions with clients and other nonprofits. Observations focused on the daily work practices of individuals working in these organizations. In addition, we observed 10 inter-organizational meetings, taking detailed field notes during approximately 17 hours of meetings. Meetings focused on finding ways to collaborate amongst organizations, educating each other on topics around food security, and developing new methods to help local communities.

LOCAL FOOD SERVICE NONPROFITS

This research focuses on nonprofit organizations working toward a shared mission of supporting a specific underserved population -- local community members in need of food assistance. These organizations deliver highly specialized food-related services in a limited geographic area that is generally county or city wide.. Services range from preparing and serving hot food to clients to collecting and delivering food resources to other client-centric nonprofits. Likewise, client interactions range across the nonprofits we studied, with some working daily with clients and others never interacting directly with the food insecure. These nonprofits tend to work together in formal and informal capacities. Various nonprofits will set up food-related programs together or simply maintain an awareness of each other's services so they can direct clients to other appropriate resources when necessary.

The Problem Space

The participants in our qualitative study all reported use of location-based information. However, how such information was used and the form it took varied based on the particular work needs, resources, and constraints of various organizations. Our field study allowed us to look across these differences and identify two goals that are fundamental to the missions of all of the nonprofits we studied and currently stretch the capacities of these organizations. Each goal could be served by the creation of LBIS tailored to this population. Before moving to our work of design considerations for these LBIS, we outline the problem space and empirically ground these findings through detailed profiles of specific stakeholders.

Goal 1: Nonprofits need help matching clients to food

The nonprofits we studied seek to alleviate hunger through a variety of food resources and attempt to match available resources to specific clients' needs. Services range from providing clients immediately accessible food items—such as goods from a food pantry—to assisting clients in registering for longer-term government programs, such as the Supplementary Nutrition Assistance Program (SNAP) or the Special Supplemental Nutrition Program for Women, Infants and Children (WIC). Such programs often have

complicated regulations, eligibility requirements, and require clients to show up at specific times and places for registration, which may hinder program entry. The ability to access and utilize these resources thus requires a level of expertise that can alienate those with limited education, literacy, and social resources. In response to this complexity, hunger-based nonprofit organizations act as intermediaries to support people getting the food resources they need [8].

Clients themselves have particular needs and preferences that must be understood and modeled in any information system designed to support the food resource delivery process. At a rough level, need is delineated between emergency food needs and supplemental food needs, with the term “emergency” indicating that the individual needs assistance very soon, usually within a day. Clients often also have dietary restrictions, ethnic preferences, or preparation preferences. For example, individuals living in hotels might not be able to cook food, thereby requiring food that can be consumed without a lot of additional preparation. When designing systems to interact with such hunger-based nonprofits and communities, the complexity of how food resources are defined and understood by multiple stakeholders must be accounted for within the designed artifacts.

Finally, those wishing to support organizations that provide food resources must also navigate a complex delineation of acceptable donations, locations, and times for drop-offs. For example, food resources in our fieldwork were often delineated in the following categories: hot and prepared foods, short term foods (like fresh produce, dairy, and other foods requiring refrigeration), and shelf-stable foods (like canned and boxed items). These categories have semantic meaning related to the length of time they can be stored and how long it takes to reach the client and thus impacts the organization's ability to accept and process such items. Therefore, in order to render food donations usable, nonprofits must educate and organize those attempting to provide resources.

Goal 2: Nonprofits need to connect with new sources of food

While food banks often provide a variety of physical food items to other nonprofit organizations for distribution, the food they distribute is a limited resource. Collectively, nonprofit organizations experience difficulties serving their client populations because food resources are limited and demand continues to rise [1, 31, 35]. Tightening budgets and limited food resources, may force food banks to restrict the number of organizations they distribute to because they have a limited amount of food to allocate.

From a food bank perspective, one of our great challenges and frustrations is that we never have never have enough food to go around. We have to limit how much each of our charities take. We have a waiting list of 36-38 organizations that have applied and want to be members of our food bank,

but we have to say, 'Sorry, we don't have enough food for you'. It seems both ironic and tragic that we [as a food bank] would have to be so restrictive in terms of the food we provide to people and to other nonprofits.

– John¹, Executive Director of a Food Bank

These food shortages can be addressed in two ways. First, nonprofit organizations can shift the burden away from local resources by assisting clients with the process of applying for governmental food assistance programs (e.g., WIC, SNAP) dedicated to alleviating hunger. Second, by making connections between nonprofits and food donors, such as restaurants with leftover food or farmers with surplus crops, food banks can help infuse local communities with previously untapped resources. However, there are notable overheads for potential donors. Not all nonprofits can accept and process “hot and prepared” foods or fresh produce. Therefore, there is an opportunity to facilitate donations by establishing a matching process between potential donors and nonprofits to route donations to the right time and place to meet current demands. In sum, a multi-pronged approach is necessary to help nonprofits connect with new sources of food that includes both supporting participation in supplemental governmental assistance programs and facilitating resource allocation across the ecology of food providers and distributors.

Nonprofit Stakeholder Profiles

In this section, we use profiles to highlight information usage and requests that occur within food assistance nonprofit organizations. These profiles represent a blend of personalities and experiences from our fieldwork. Each profile is grounded in our empirical data, including interviews and participant observation, but the details are used in amalgamation to make the specifics of this complex context accessible to our readers. One profile focuses on the work of those within a nonprofit attempting to match clients with food resources while the other takes the perspective of someone working with a nonprofit oriented around gathering food resources from the community. Both of these stakeholders have location-based information practices that could be enhanced by a collaborative LBIS.

These profiles reveal the ways in which various nonprofit organizations are interconnected and the range of information needs required to accomplish everyday tasks. Further, they highlight how the lack of certain types of information can cause informational bottlenecks, inefficiencies, and lost opportunities to serve populations in need.

“The Secretary”

Susan, a retired teacher, is a volunteer at a community center that provides food resource support for local

residents. When local residents call her community center seeking food assistance, Susan provides information and advice. Susan uses her knowledge about the various food-resource programs and her working relationships with other nonprofit organizations. Depending on the needs of the client, she may recommend that the client come to the community center to pick up food resources (usually called “emergency assistance”) or recommend the client connect with another person who can help him or her sign up for supplemental nutrition programs. Susan also receives calls from people looking to donate food resources. Depending on the amount and type of food, Susan directs the donor to donate to an organization that can make use of the food, typically a local food pantry that directly services the community. After each encounter, Susan records her interactions and the type of assistance provided in a notebook. Creating accounts of her work is important for the community center because many donors and government agencies require nonprofits to articulate their community impact to receive resources.

In terms of location based information needs, secretaries like Susan must assess the needs of the client on the spot, match them with the appropriate nonprofit service agency, and provide directions to that service agency. This type of information work requires in-depth knowledge of the variety of programs available. This includes understanding eligibility requirements for multiple food resource programs and knowing which types of resources organizations can use at any given point in time.

“The Weekend Nonprofit Gardener”

On the weekends, George, an enthusiast gardener, leads a small local nonprofit that harvests orchards and other local produce. He is one of what are sometimes called food rescuers or “gleaners,” harvesting his neighbors’ apple trees or vegetable patches. George then donates, delivers, and distributes the collected produce amongst several nonprofit organizations that directly serve the local food insecure populations – in this case, a food pantry and two soup kitchens. Like other gleaners, George’s mission is to decrease food waste through finding and distributing underutilized food resources into the community.

In terms of location based information needs George must connect with homeowners who want to have their property gleaned. Beyond an initial introduction, this type of nonprofit must also often provide ways for these landowners to account for their donation and release the landowners from liability for accidents that may occur during gleaning activities. Second, the relatively short shelf life of the harvested produce requires that these nonprofits quickly find other nonprofit organizations, typically food pantries, to process and distribute the produce directly to community members. Nonprofits directly servicing clients place a high value on this fresh produce as it is in high demand by clients. Gleaners fit a particular niche in the nonprofit sector since larger organizations are often unable to perform this work. These location-based practices require

¹ All names are pseudonyms.

not only location information, but also working relationships that develop over time.

These vignettes highlight the relationship between the different types of people and organizations addressing issues of food insecurity and their unique location-based information practices. Understanding the context of this work and these relationships is prerequisite for designing location-based information systems for this population.

COOPERATIVE DESIGN

Following our qualitative field study, we engaged in cooperative design sessions to understand how particular technologies might affect the goals and practices of stakeholders in this arena. Working closely with three key participants from two organizations, we co-sketched a variety of potential design concepts to understand how particular technologies might work within and across these organizations. These sessions added nuance to our thinking on how organizations work together to assist their local communities. The result of these cooperative design sessions included sketches and a functional prototype. When working with low-resourced populations and organizations with limited exposure to ubicomp systems, it can be helpful to conduct interviews with a functional prototype in hand. We thus conducted seven additional interviews with hunger-based nonprofit workers from five different organizations. During the interviews, we used our prototype and sketches to solicit feedback on our design concepts to further refine both our overall design considerations and prototype specifically.

During these interviews, we engaged in concept validation by requesting feedback on potential mapping application designs to investigate how such technologies might play a role in their work. We tailored our feedback requests depending on the role of each participant.

DESIGN CONSIDERATIONS

In this section, we present four design considerations for designing LBIS for nonprofit organizations and related stakeholders who are focused on serving under-resourced populations within their local communities. For each consideration, we ground our results in empirical data and share concrete design examples. These design considerations seek to enhance how organizations work internally, serve clients, and collaborate with other organizations to provide food resource assistance in their local communities. However, each of these considerations carries implications for the organic interactions and social relations that occur within this nonprofit space. While not a comprehensive list, we end each design consideration with a brief discussion of possible tensions that should be taken into account when designing in this arena.

#1 Support the Role of Intermediaries

A variety of stakeholders play the role of an intermediary between food resources and people in need [17]. In the context of our work, these individuals play a critical role for clients by stitching together customized sets of resources

from a variety of programs and organizations. For example, intermediaries, such as food bank secretaries, might offer advice to clients on how to navigate various organizations and programs in order to secure food resources.

Intermediaries often connect community members to the network of social support provided by the ecology of food assistive nonprofits. Once the intermediary determines a client's needs, he/she will often provide additional information to connect him or her to other assistive organizations and programs.

If someone comes in for emergency food because there's no food in their home, there's a whole lot more need than just food. That one box of food -- although it might fill their stomach tonight, will it help them much beyond that? If it only feeds them for two maybe three days, then nothing has really changed. That's why the key component to that is getting them into advocacy programs. Let's find out what's going on and help address the problem.

– Donna, Director of a Low-Income Family Oriented Nonprofit Organization

These supplemental food programs assist community members for longer periods of time while attempting to address the client's specific issues. This work often includes finding and referring clients to programs located at other organizations. Beyond interacting with clients, intermediaries can also become hubs of information for people seeking to donate food resources to nonprofit organizations. Usually, individual donors looking to offer resources may be from a smaller nonprofit or even an individual unaffiliated with a nonprofit. In such scenarios secretaries are in a position to connect these donors to organizations that can use their resources. Such practices suggest that designing for the intermediary benefits multiple stakeholders, including community members, potential volunteers, and other nonprofit organizations.

By explicitly designing with intermediaries in mind [19], we can explore opportunities to better connect community members with a network of social support. Given the importance of these intermediaries to particular clients and nonprofits alike, design should seek to strengthen how these people can provide access, information, and resources to multiple stakeholders.

First, by mapping currently existing locations of food resources available to low-income individuals, a system could provide intermediaries better understanding of available resources. For example, a system that maps currently available resources by location would support intermediaries in matching people and food and encourage the discovery of new potential places that could assist clients. Reducing the amount of travel to food resources would lessen the potential for hardships and barriers specific to the food insecure populations. Coupling these data with complementary location services creates new

functionality. For example, using public transit information helps find not just the physically closest services by proximity but also the accessible locations that might best serve clients' needs. Further, it could help food advocates and community members craft arguments to local governments as to why public transit should be serving particular locations.

To support the work of the intermediary through location-based information system, designers must consider multiple users and technological beneficiaries, including the "intermediary" and the client seeking services. The variance in the type of users presents an opportunity to design interactions across multiple platforms, in which transactions are partially handled by the client and partially by the intermediary. Given that client populations often own mobile phones² but not necessarily personal computers, a system could allow a client to send location information from the mobile device to the intermediary who could then explore the feasible options and present them to the client. This expansion of the accessible food options for the client is made feasible through the work of linking multiple, but previously disconnected, information systems.

To return to our profiles, clients often call Susan, the nonprofit secretary, to request food assistance. After having a quick conversation with the client about what assistance is needed, Susan might learn that the client doesn't have a car. During their conversation, the client could tell Susan his current location. In turn, Susan could then use that information to tailor her search results to recommend a nearby food pantry that is accessible using public transit. Susan is then able to provide her client information on the food pantry's location and hours of operation and the bus route necessary to get to the food pantry. These client-intermediary interactions benefit the client because intermediaries like Susan often recommend a set of programs that work well together to help fit the client's particular food needs. Even if clients are able to directly access the LBIS, intermediaries have an informed and intimate understanding of the often-complex rules and regulations tied to various available services. Additionally, intermediaries can sometimes provide solutions to the underlying causes of the client's need, possibly suggesting services about which the client may not have been aware.

Of course, any design that attempts to support the role of intermediaries must also consider the unique position such people play in the ecosystem. In acting as boundary spanners and information brokers, intermediaries are most successful when they are able to work at the margins between established organizations—creating social capital with diverse individuals, learning about potential loopholes in existing services, and brokering alignments between

clients and various potential resources. Thus, any system that formalizes these practices (such as an automatic recommender system) at the cost of flexibility and individual agency may end up damaging the ability of intermediaries to perform this unique and valuable role.

#2 Match Resources to Need

Nonprofits face significant challenges in both matching client needs with specific programs and building connections between organizations that distribute food and potential food donors. Thus, not only should LBIS systems take the brokering role of intermediaries into consideration, they should also foster communication among nonprofits themselves. Ideally, a system would promote access to information about various programs and resources, provide avenues for investigating the services that others offer, and incorporate the ability to broadcast information to others in the ecosystem. Currently, even when programs are identified, nonprofits have limited ability to know about, let alone accommodate, a fellow agency's ability to support new clients.

To facilitate this coordination, LBIS could allow nonprofits to indicate their location and business hours, details about the various programs they offer, eligibility requirements etc. A LBIS could also support individuals seeking to donate food resources, such as our gleaner George, by allowing organizations to indicate their food needs and preferences, ability to process certain types of food, and business hours during which that are able to receive food. Finally, such a system could also let potential donors post that they have excess resources they are willing to donate, even if they lack the manpower or time to deliver those resources.

The benefits of such a system for Susan are easy to imagine. For example, if her nonprofit's soup kitchen has temporarily run out of food she would be unable to provide immediate aid for a young couple who just arrived and are in need of assistance. While still informing them about some longer-term services, Susan could use the LBIS to locate a nearby organization and confirm that this location still has food for the day. In addition, Susan could provide the couple with information about the closest organization to the address of a family member the couple will be staying with in the upcoming weekend.

Before exiting the LBIS, Susan could also indicate that her organization could use some additional food and adjust the hours listed during which they accept donations -- assuming she is willing to stay late if it means helping feed a few more mouths. Meanwhile, George, our gleaner, frequently donates surplus produce to nonprofits. He could use the LBIS to find a donation site and find several locations (including Susan's nonprofit) requesting additional food resources. With a finite amount of produce, no gleaner can donate to them all, but he might choose Susan's because he is familiar with her and knows she can quickly process and distribute fresh produce to the local neighborhood. Learning

² 80% of adults living in households with less than \$30,000 per year own cellphones and 43% own smartphones. [22].

that Susan is short on food for the day George might also calls his wife to see if the bakery where she works might have any extra items at the end of the day that she can deliver on her way home from work.

While publicizing resources and need might help streamline how food is distributed to clients, making information public carries potential burdens and accountabilities for organizations that should be taken into consideration. Supply and demand is difficult to manage: advertising resources might send too many clients to an organization while publicizing need might result in too much food.

In addition, aligning supply and demand in any network involves more than simply managing a rational flow of goods and services. Publicizing an over or under abundance of resources can carry implications for how nonprofits understand, assess, and orient toward each other. Nonprofits often experience cyclical patterns of surplus of and need for food resources. However, making these patterns visible without sufficient orienting information might expose organizations to inaccurate and potentially damaging assessments of effectiveness or efficiency. Any LBIS should provide organizations (and individuals) the ability to contextualize their needs in a point in time – denoting how long they expect to have resources, why they are looking for assistance, etc.

#3 Control Visibility

Beyond the needs of their clients, nonprofit organizations have their own needs and experiences to consider. While all the nonprofit staff we interviewed expressed a desire to serve as many clients as possible, these interviewees also expressed concerns about being overwhelmed with more requests for aid than they are able to support. For example, concerns may arise about publicly posting location and contact information online.

[Nonprofits] don't just publish this information ... because they're often very small they can't handle a bunch of inquiries or a bunch of new clients so they're sensitive to sharing that information.

– Vanessa, Executive Director of a Client-Centric Food Service Nonprofit Organization

For a nonprofit, controlling visibility is a means of communicating (or not) the availability of aid. As Vanessa's quote demonstrates, these nonprofits have a limited ability to manage unexpected influxes of clients. Because visibility of information implicitly communicates the availability of aid, information systems should allow organizations as much control over this information as possible. In addition to allowing certain information to be locally private to a particular nonprofit, finer grain controls would allow organizations to control the visibility of particular services and indicate current needs.

Returning to our profiles, imagine that Susan's nonprofit organization has joined a cross-organizational system to be easily visible to other organizations and potential clients.

However, they have developed a backlog of clients and the phone has not stopped ringing. Susan has a quick strategy meeting with her volunteer coordinator where they decide to update the organization's account to indicate that partner agencies should temporarily avoid sending them new clients until things have settled down. In addition to passively informing other agencies to send clients elsewhere, Susan is also able to indicate that they could use some extra volunteer support to man the phones in order to let Susan's team focus on working through the client backlog.

Controlling visibility is especially important for smaller organizations, because these organizations could benefit the most from new technological and informational resources but may be the least able to control how new technologies impact them [14]. If improperly designed, LBIS could, in fact, intensify disparities amongst nonprofits by designing in ways that may unintentionally preference larger nonprofits.

#4 Document the organization's work and impact

Nonprofit organizations typically rely on private donations and grants to fund their operations. Often, as a condition for such funding, nonprofits must demonstrate how they have previously created impact in their community and the impact of any currently granted funds.

Creating accounts of impact can be quite difficult. Funding sources often require measurement statistics that contrast with the nonprofit's own methods or even their overall mission. One common incongruence comes when donors and funders request "unduplicated numbers" – a count of the unique clients served by a particular donation – as a way of measuring impact of a particular program. However, nonprofit organizations typically take a holistic view of clients and may use multiple programs to assist an individual client. Here, the nonprofit prioritizes the amount of overall aid, rather than how specific donations break down in terms of number of unique individuals served.

For example, the director of a nonprofit organization running multiple concurrent programs described issues with certain types of funding requirements that do not count their assistive programs separately.

So for us, as [a large nonprofit] we run so many different programs, how is that fair to even judge what we do like that? So we give a client an emergency box of food, but they have already been counted for the fact that they're in another supplemental program and that they're getting [name of a program] and we are assisting them with all of these other programs such as family advocacy or summer tutoring. You know this all costs money, but I can't count them. And for us, that's difficult because we need the funding. That's how we survive.

– Elizabeth, Program Director of a Low-Income Family-Oriented Nonprofit Organization

Given that creating accounts of how nonprofits work is vital for securing funding, these findings suggest that wherever possible, design should track the particulars of how assistance is delivered. This would include client-nonprofit interactions (*i.e.*, where individuals seeking assistance are coming from; where they are going; the type of assistance delivered, etc.) and how food resources are distributed (*i.e.*, type of food; amount of food; location of service provider, etc.).

Tracking such information presents a design opportunity for collaborative LBIS to produce novel ways to represent the work and impact of different nonprofits collectively working to address a social need. For example, George, the backyard gleaner, could use such a system to track the various locations where he donates food resources. Such a system, if used collaboratively amongst nonprofits, could also give George the information to show where the people that benefit from his donations geographically live. Similarly, Susan would have an easier time accessing demographics of people served according to the various food-assistance programs and resources she matches them with.

Helping nonprofits find ways to track activities and articulate impact could enhance their ability to position themselves to potential funders and thus increase their chances of receiving funding. Of course, competition for funding can be fierce. Thus, the system must be sensitive to how information about activities can impact organizations and not presume that the system is neutral. The system should allow nonprofits to tailor not only how their activities are assessed and measured by the LBIS, but also who has access to this information. Funding pools (*e.g.*, government programs, private donors, institutions, etc.) are limited and finite resources. Unfortunately, while nonprofits may be on the same ‘side’ in terms of addressing a broader social need, they are often in competition for their viability. Thus, organizations would need authority over their own data and rationalized accounts of impact.

DISCUSSION

In this work, we are interested in designing for the ebb and flow of location information tied to time-based services and organizations that work together to address the hunger needs of their local communities. In what follows, we discuss the information complexity and density in which LBIS must engage to productively provide a platform for action.

There are a wide variety of players and technologies involved in any location-based information system (LBIS), from the databases and positioning systems, to the data entry technicians, and the consumers of the information. In terms of hunger-based LBIS, additional constraints of time (due to spoilage on the one hand and the need of the hungry on the other) and client eligibility (in terms of both

governmental and non-governmental programs) add to the complexity of these data. Together these constraints create a spatial patchwork in which organizational reach and jurisdiction, hunger patterns, public transportation, food spoilage, and the physical location of food resources and organizations all overlap. Each of these components produces different spatial and temporal patterns that the staff of support organizations and their clients must navigate. Locations of food production and distribution shift, as do need and the location of hunger. Meanwhile, some assistance programs address immediate need while others set the stage for longer-term relationships with assistance programs.

Our work aligns with prior literature understanding the concept of “place” as sites of cultural production [9] and organizational collaboration [2], but we further detail what it means to understand place in terms of LBIS for hunger-based nonprofits. By physically moving through geographic space, delivering food resources, and supporting clients in person, the volunteers and staff of the nonprofit organizations we studied create places—zones within which they work—from their lived experiences that go beyond the standard views of spaces as locations within an LBIS [9].

In our analysis, these places can be characterized by their *multiplicity of purpose*, *ephemerality of resources*, and *orientation towards goals*. By *multiplicity of purpose*, we refer to how physical locations often function, depending on time and need, as sites for multiple programs and services. For example, a church may offer soup kitchen services all day, but only offer application assistance for governmental nutrition programs in the evening. Thus the articulation of information about programs and services supersedes knowledge of a specific location. Meanwhile, LBIS meant to address hunger-based nonprofits’ needs, must contend with the *ephemerality of resources*. These resources include physical resources (such as food and physical space) and organizational resources (such as staff, volunteers and their program knowledge), among others. Resources may literally have a shelf life and an organization’s capability to address the needs of its community is largely based on their ability to harness these constrained ephemeral resources. Lastly, these places can be understood based on their *orientation towards goals*. Places become a space where the objectives of community members and nonprofits can be addressed and fulfilled. Nonprofit workers and clients physically come together in space to transfer resources.

This incredibly complex and nuanced view of these places, however, is not being captured by current practices or information systems. The nonprofit organizations that serve the local needs of the food insecure largely rely on an assortment of paper-based and computerized information systems, many of which use location as their key and some that are organized by other means requiring translation into locally meaningful knowledge.

Although it is tempting to imagine simply translating the information currently stored in so many different formats into a simple digital map, the kind of *spatial patchwork* we saw created and navigated on a daily basis requires a different approach. A digital version of the current information systems would do much to improve the scale and resolution of the data. However, such a system would still be unable to recognize the temporal nature of a need or of a resource and incapable of representing the emergent spatialities created by everyday practice.

Instead, LBIS in this context require numerous views into and across the data, at varying levels of visibility to other organizations or to clients. Such a system could then serve as a platform from which to develop new understandings of the places and spaces in the local food resource ecology. It could also become a valued communication tool to create connections amongst organizations, enable effective distribution of resources, and create participatory or political engagements with this location-based information.

CONCLUSION & FUTURE WORK

The coordination of donations and distribution of food resources in support of those in need requires leveraging location-based information while coordinating amongst a variety of actors. The ability to match clients with information, services, and food resources can be greatly improved through the use of a LBIS. The ability to effectively gather and distribute food resources could be similarly improved. However, the immense constraints of facing under-resourced organizations with shifting needs requires that the “location” in the LBIS represent the somewhat fragmented and patched together zones of influence and action we saw in our fieldwork.

In particular, our research indicates that the design of LBIS for these settings must include consideration of four major issues. First, these systems must *support the role of the intermediary* by helping these intermediaries understand the availability of potential resources. Second, a LBIS must *match client needs to the available resources* to enable those people tasked with matching clients to various resources and programs to determine client need and direct individuals to appropriate resources—whether it be immediate food assistance or help with applying for governmental services. Third, LBIS must allow individual organizations to *control visibility of their organization*, of the places and populations they serve, and of their resources. In this way, the information stored in the LBIS could make legible various pieces of information in certain ways for certain groups and in other ways for other groups. Finally, LBIS must *support accountability practices* and allow organizations to document who is receiving services, what programs and donations are contributing to each client’s assistance, and how ‘impact’ can be measured along various dimensions.

In this work we have described the need for, and constraints around, location-based information in support of the

alleviation of hunger. This work builds on an 18-month qualitative study, including the creation and testing of design considerations and a prototype LBIS. This research indicates the need to explore the notion of “location” alongside other constraints and issues in the design of LBIS, leaving open additional research to create and evaluate such a system in practice.

ACKNOWLEDGMENTS

We thank the participants in this research and our undergraduate research assistants Minhnhut Thanh Vo, Victor Lelas, and Ching-Wen Wendy Chen for sharing their time and insights. We appreciate the thoughtful feedback from Irina Shklovski and our anonymous reviewers. This work was supported in part by the Intel Science and Technology Center for Social Computing and the National Science Foundation’s Graduate Research Fellowship Program. This work is covered by human subjects protocol #2011-8168 at the University of California, Irvine.

REFERENCES

1. Bosman, J. “Newly Poor Swell Lines at Food Banks.” The New York Times. February 19, 2009. Web. <http://www.nytimes.com/2009/02/20/nyregion/20food.html>
2. Ciolfi, L., Fitzpatrick, G., & Bannon, L. Settings for Collaboration: the Role of Place. *Comput. Supported Coop. Work* 17, 2-3 (April 2008), 91-96.
3. Chon, Y., Lane, N. D., Li, F., Cha, H., & Zhao, F.. Automatically Characterizing Places with Opportunistic CrowdSensing using Smartphones. In *Proc. 14th Int. conf. Ubiquitous Computing (UbiComp’12)*.
4. Consolvo, S., Smith, I. E., Matthews, T., LaMarca, A., Tabert, J., & Powledge, P. Location disclosure to social relations. *Proc. of the SIGCHI conf.on Human factors in computing systems - CHI ’05* (p. 81). New York, New York, USA: ACM Press.
5. Dearman, D., Varshavsky, A., De Lara, E., & Truong, K. An exploration of location error estimation. *UbiComp 2007: Ubiquitous Computing*, 181-198
6. Dourish, P., & Anderson, K. Collective information practice: Exploring privacy and security as social and cultural phenomena. *Human-computer interaction*, 21(3), 2006. 319-342.
7. Diamond, J. P., Fiesler, C., & Bruckman, A.S. Domestic Violence and ICTs. *Interacting with Computers*. 2011. 23:5, 413-421.
8. Dombrowski, L., Volda, A., Hayes, G., & Mazmanian, M. The labor practices of service mediation: a study of the work practices of food assistance outreach. In *Proc. of the 2012 ACM annual conf.on Human Factors in Computing Systems (CHI ’12)*. ACM, New York, NY, USA, 1977-1986.
9. Harrison, S. and Dourish, P. Re-place-ing space: the roles of place and space in collaborative systems. In *Proceedings of the 1996 ACM conf.on Computer supported cooperative work (CSCW ’96)*, 1996. Mark S. Ackerman (Ed.). ACM, New York, NY, USA, 67-76.

10. Hsieh, G., Tang, K. P., Low, W. Y., & Hong, J. I. (2007). Field Deployment of IMBuddy: A Study of Privacy Control and Feedback Mechanisms for Contextual IM. *Proc. of the 9th international on Ubiquitous computing*, 2007, 91-108. Springer-Verlag.
11. Humphreys, L. Mobile social networks and urban public space. *New Media & Society*. 2010. 12:763-778.
12. Iachello, G., & Hong, J. End-User Privacy in Human-Computer Interaction. *Foundations and Trends® in Human-Computer Interaction*, 1(1), 1-137.
13. Kirschenbaum, J., & Kunamneni, R. The organizational divide. In L. J. Servon (Ed.), *Bridging the digital divide: Technology, community, and public policy* (pp. 177-198). (2002). Malden, MA: Blackwell Publishing.
14. Kvasny, L. & Lee, R. e-Government services for faith-based organizations: Bridging the organizational divide. *Government Information Quarterly*. 2011, 28. 66-73.
15. Le Dantec, C.A. Participation and publics: supporting community engagement. In *Proc. of the SIGCHI conf.on Human Factors in Computing Systems (CHI '12)*. 2012. ACM, New York, NY, USA, 1351-1360.
16. Le Dantec, C.A., Edwards, W.K. The View From the Trenches: Organization, Power, and Technology at Two Nonprofits Homeless Outreach Centers. In *Proc. of the 2008 conf. on Computer Supported Cooperative Work*, 2008, New York, NY, USA. ACM Press.
17. Pothukuchi, K., Community Food Assessment: A First Step in Planning for Community Food Security. *Journal of Planning Education and Research*. June 2004. Vol 23 no4. 356-377.
18. Roberson, J. and Nardi, B. Survival needs and social inclusion: Technology use among the homeless. In *Proc. CSCW 2010*, ACM Press, (2010), 445-448.
19. Sambasivan, N., Cutrell, E., Toyama, K. & Nardi, B. Intermediated technology use in developing communities, In *Proc. of the 28th international conf.on Human factors in computing systems*, April 10-15, 2010, Atlanta, Georgia, USA.
20. Schneider, J. Small, minority-based nonprofits in the information age. *Nonprofit Management & Leadership*, 2003. 13(4), 383-399.
21. Shklovski, I., Vertesi, J., Troshynski, E., and Dourish, P., The commodification of location: dynamics of power in location-based systems. In *proc. of the 11th international on Ubiquitous computing (UbiComp '09)* ACM, New York, NY, USA. 11-20.
22. Smith, A., (2013). "Smartphone Ownership - 2013 Update." Pew Research Center, Washington, D.C., June 5, 2013. http://pewinternet.org/~media/Files/Reports/2013/PIP_Smartphone_adoption_2013.pdf accessed June 15, 2013.
23. Sohn, T., Varshavsky, A., LaMarca, A., Chen, M., Choudhury, T., Smith, I., & De Lara, E. (2006). Mobility detection using everyday GSM traces. *UbiComp 2006: Ubiquitous Computing*, 212-224.
24. Stoll, J., Edwards, W.K. and Mynatt, E.D. Interorganizational coordination and awareness in a nonprofit ecosystem. *Proc. CSCW 2010*, ACM Press, 51-60.
25. Stoll, J., Edwards, W. K., and Foot, K. Between us and them: building connectedness within civic networks. In *Proc. of the ACM 2012 conf.on Computer Supported Cooperative Work (CSCW '12)*. ACM, New York, NY, USA, 237-240.
26. Sutko, D. M., & de Souza e Silva, A. Location-aware mobile media and urban sociability. *New Media & Society*, 2011. 13(5), 807-823. doi:10.1177/1461444810385202
27. Tang, K. P., Lin, J., Hong, J. I., Siewiorek, D. P., & Sadeh, N. Rethinking location sharing: exploring the implications of social-driven vs. purpose-driven location sharing. In *Proc. of the 12th ACM Ubiquitous computing 2010*. ACM Press. pp. 85-94.
28. Troshynski, E., Lee, C., Dourish, P. Accountabilities of presence: reframing location-based systems. In *proc of SIGCHI conf. on Human factors in Computing Systems (CHI '08)*. ACM, New York, NY. USA. 487-496.
29. Volda, A., Harmon, E. & Al-Ani, B. Homebrew databases: Complexities of everyday information management in nonprofit organizations. In *Proc of the ACM SIGCHI conf.on Human Factors in Computing Systems (CHI 2011)*. Vancouver, BC, May 7-12. New York: ACM Press, pp. 915-924
30. Volda, A., Harmon, E., and Al-Ani, B. Bridging between organizations and the public: volunteer coordinators' uneasy relationship with social computing. In *Proc. of the SIGCHI conf. on Human Factors in Computing Systems (CHI '12)*. ACM, New York, NY, USA, 1967-1976.
31. Warshawsky, D. N., New power relations served here: The growth of food banking in Chicago. *Geoforum*. Vol 51, 5. 2010. 763-775.
32. Woelfer, J. P., and Hendry, D.G. Stabilizing homeless young people with information and place. *JASIST* 60, 11, 2009. 2300--2312.
33. Woelfer, J. P., and Hendry, D.G. Designing ubiquitous information systems for a community of homeless young people: precaution and a way forward. *Personal Ubiquitous Comput.* 15, 6 (August 2011), 565-573.
34. Zhang, W., Lu, Y., Meng, Y., & Yu, H. Easy picker: picking objects aided by passive RFIDs. In *Proc. of the 13th international conference on Ubiquitous computing 2011*. (pp. 573-574). ACM.
35. Zezima, K. "Food Banks, in a Squeeze, Tighten Belts." *The New York Times*. November 30, 2007. Web. <http://www.nytimes.com/2007/11/30/us/30food.htm>