

# Designing a Phone Broadcasting System for Urban Sex Workers in India

**Nithya Sambasivan**  
Department of Informatics  
University of California  
Irvine, CA 92617  
nsambasi@uci.edu

**Julie Sage Weber & Edward Cutrell**  
Microsoft Research India  
Sadashivanagar  
Bangalore, India 560080  
julie.weber@gmail.com, cutrell@microsoft.com

## ABSTRACT

In this paper, we present the design, implementation, and deployment of a phone-based broadcasting system designed for reaching out to at-risk populations in urban India. We worked in collaboration with Pragati, a non-governmental organization dedicated to assisting Urban Sex Workers (USWs) in Bangalore, India, with the goal of improving Pragati's outreach to the women they serve. We conducted ethnographic action research to understand and address the needs of Pragati and the lifestyles of USWs. Responding to the unique design constraints of the USW community such as specific privacy and timing constraints, a desire to remain invisible, and the unusually high rate of mobile phone use, we designed a phone-based broadcasting system for Pragati. We then deployed the system on four different occasions and application areas. We present the results and key findings from our study, and conclude with a discussion on how designing for particularly difficult cases such as USWs can shed new light on the design of mobile applications for the developing world in general, such as challenging ubiquity and phone numbers as identity.

## Author Keywords

HCI4D, ICT4D, M4D, Urban Sex Workers, India.

## ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI)

## General Terms

Design

## INTRODUCTION

Governmental and civil society organizations for socio-economic development organize and support target communities, helping them access a broad range of services such as health care, education, and business development [13]. Communication infrastructures are crucial in reaching out to these communities for notifications, announcements, advertising, reminders, and emergency services during crises. Communications are also used for disseminating information about welfare services and for effecting

behavior change (e.g., public service announcements). Organizations use several mechanisms to communicate with their members—television and radio advertisements, Internet services, Short Messaging Service (SMS), printed flyers, word-of-mouth, and so on.

In the developing world, organizations working for socio-economic development are stifled by several factors in their communication reach, including literacy and infrastructure constraints. Moreover, broadcast media are not always relevant to the entire target population: they can be impersonal or non-local (e.g., radio and television); programming can be expensive (e.g., television); and content may rely on literacy (e.g., textual flyers and SMS).

Mobile phones present an excellent opportunity to reach out to target populations in the developing world. As of July 2010, the overall tele-density in India was 58.17% (688 million subscribers with 2.5% monthly growth rate) [1], with arguably a larger actual usage base due to shared and pay phones [15]. By using voice content, phones are unconstrained by literacy concerns and they support the existing oral formats of everyday conversation and radio listenership [7,13]. By featuring the voice of a familiar leader or peer, phone systems can provide a rich means to leverage existing institutional and interpersonal trust. Moreover, by modifying content, targeted or personalized message broadcasts can be scaled to very large audiences.

We designed, implemented, and observed a phone-based broadcasting system for Pragati: a non-profit, healthcare project targeted at Urban Sex Workers (USWs) in Bangalore, India. USWs constitute a unique and particularly challenging group for socio-economic development work: they are highly marginalized by society, vulnerable to HIV and other Sexually Transmitted Infections (STIs), and are often very poor. At the same time, USWs are technologically well-connected, with an exceedingly high mobile phone tele-density of 97%. The Pragati project currently reaches out to its USW members through word-of-mouth via its field workers, who in turn communicate and disseminate HIV treatment and prevention strategies. However, the project faces several challenges in connecting with USWs. Word-of-mouth scales poorly, with delays in communication, especially for emergency notifications. In addition, USWs are highly

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.

CHI 2011, May 7–12, 2011, Vancouver, BC, Canada.

Copyright 2011 ACM 978-1-4503-0267-8/11/05....\$10.00.

mobile and there are specific dependencies on their schedules for when they may be available for contact.

We adapted an automated calling system to make phone calls to Pragati's USW members and play a variety of pre-recorded audio messages for different reminders and announcements. In addition to common developing-world impediments (e.g., resource and educational constraints), we needed to accommodate the maintenance of dual identities of USWs (not revealing their professional identities to their families), scattered populations, urban migration, and privacy concerns.

We believe that our findings can generalize to other populations that may be vulnerable, mobile, untrackable, or nervous, and to the institutions trying to reach out to them, such as migrant Bangladeshi workers in India, war-torn Sudanese nomads, and homosexuals in Saudi Arabia. Our motivation to work with the USWs stems from the fact that despite their social marginalization and economic and health vulnerabilities, they have very high telecom penetration. We believe that USWs present us with a unique opportunity to augur technological ideas for other user groups facing similar socio-economic issues, but where technology is steadily penetrating. We feel our primary contribution is the design of a broadcasting system for a marginalized population; we also identify the unique lifestyle issues and design implications of interactive systems for invisible and wary populations.

In this paper, we report our ethnographically-inspired study and field trials of the phone-based broadcasting system. We describe some of the challenges in designing for USWs. We describe four different deployments of our system—a pilot announcement for an event, microfinance loan payment reminders, HIV testing advertisements, and announcements for a computer training event. We conclude with some broad lessons for the HCI4D community, including reflections on trust, mobility, ubiquity, and privacy for developing world populations.

## RELATED WORK

### Phone-based systems

Much of the prior work on phone-based communication systems has focused on sending automated reminders for appointment keeping [9] and for medication regimen adherence, including HIV [15] and Tuberculosis [19]. Such attempts have disseminated through text messages and voice messages, including Interactive Voice Response [8], albeit, through automated or impersonal voices of hired callers. All of the above studies have shown some success in improving baseline rates with the help of technology.

Several researchers have designed interactive voice-based mobile applications for the developing world, such as [7,13,17]. In their studies of usage of phone-based asynchronous voice message forums for small-scale farmers, Patel *et al.* point to the importance of complementing social media with traditional media, such as

radio [13]. Sherwani *et al.* have designed and deployed a phone-based speech interface for health workers to access replies to health queries, in spoken conversation format [17]. Other researchers have designed a phone-based user-generated audio classifieds service for the economically poor [7]. We add the case of design and study of a one-way phone-based communication system keeping the constraints of a special population in mind, like USWs.

### Non-profits and ICTs

In their work on resource-constrained non-profits, LeDantec *et al.* note the importance of ICT integration for co-ordination and communication among non-profits, and its role in providing coordinated care to vulnerable communities [11]. To the best of our knowledge, no prior research has explicitly designed or studied outreach or co-ordination of non-profits with target populations.

## FIELD METHODS

Our preliminary field study was targeted at gaining an understanding of the function of the organization and the lives of the urban sex workers. In particular, our inquiry probed into entry into the sex trade; identity management of USWs; sites, pay scales, and entities in sex trade; physical, financial, and emotional security; and knowledge of STIs.

Our study was ethnographic in spirit; we employed participant and non-participant observation, combined with semi-structured interviews. In order to understand the organization planning, implementation, and logistics, we conducted interviews with various stakeholders at the Pragati office (head office staff, zone-level staff, and field workers). We employed non-participant observation at the zone 3 Swati Manne, or the drop-in shelter, which houses some beds, a microfinance payment collection center, health checkup center, and counseling center. We spent 3 months at the zone 3 Swati Manne, attending meetings, helping at events, observing transactions and checkups, and 'hanging-out' in general. Interviews were conducted in Tamil, Hindi, and Kannada by the first author. We also conducted non-participant observation at client solicitation locations, on streets and at homes and bus-stops. We conducted semi-structured interviews with 21 urban sex workers at these locations.

**Research ethics:** Conducting research with USWs entails paying special care to research ethics and informant privacy. Interviewees were asked for verbal consent before conducting interviews. No identifying information was collected, including names and addresses. Photographs were only shot in Swati Manne premises, which were post-processed for pixilation. Audio recordings were avoided for interviews—we took down notes wherever possible. In order to respect our informants' privacy and identities, we restricted our interviews to Swati Manne premises and streets. Our field access was mediated by Pragati, which helped us gain entry into the women's lives as well as avoid any possible confrontations with the police.

**Researcher values:** Our own views and values with respect to sex work have inherently biased our research. While sex work can be exploitative and risky, we decided to view our informants as independent professionals, family members, colleagues and friends in their own right, instead of viewing them as victims of their circumstances. Such a position helped us understand the agency, relationships, and identities constructed in their everyday realities.

### **PROJECT PRAGATI AND URBAN SEX WORKERS**

Project Pragati (meaning “progress”) is a healthcare project for USWs, primarily targeted at HIV prevention and treatment. It also provides auxiliary services, such as microfinance banking and counseling. Pragati was created in the year 2005, when Bangalore was surveyed and an HIV prevalence of 12.1% among USWs was noted.

The Pragati organizational structure is constituted by employees both from within and outside the sex worker community. The head office administration comprises non-community members and community members. As the structure gets closer to grassroots, it is essentially run by community members. In particular, outreach workers (*Jananis*) and field workers (*Jeevikas*) are chosen from the sex worker community.

Jeevikas, or fulltime field workers, are senior USWs who may continue to practice their trade in their free time. They are chosen from the community based on criteria like friendliness with other USWs and local expertise. They visit the field regularly during times when USWs are available in the field, i.e., soliciting clients. This poses a logistical challenge, since USWs are usually busy and not always available. Jeevikas monitor health checkups, distribute condoms to USWs directly and place condoms in strategic public areas (like paid restrooms and parks), offer counseling, and monitor monetary payments. Jananis, or outreach workers, monitor and train Jeevikas as well as visit the field themselves. Currently, dissemination is largely driven by the Jananis and Jeevikas, who deliver information back and forth to the grassroots and Pragati officers.

### **USW overview**

India is home to an estimated 2.8 million USWs [2]. USWs in Bangalore may work full-time or part-time, owing to the informal, flexible nature of work. Broadly, the Bangalore-based sex trade is divided into four categories (breakdown and percentages come from Pragati officers):

*Street-based sex trade:* Roughly 50% of the Bangalore USWs are street-based. They solicit in the streets and go with clients to motels and public-private spaces, like restrooms. Most of them are homeless, seeking rest in bus stops and railway stations. They are the most vulnerable type of USWs, perpetually dealing with the police and rowdies. They generally carry out the trade at night.

*Home-based sex trade:* About 40% of the USWs are home-based. While solicitation is carried out on the streets, they

rent out rooms in an apartment or house. Several home-based USWs are married with children. They work during the day and return to their families at night. Such a lifestyle is built upon a dual identity—the USWs tell their families that they work innocuous jobs, such as domestic work or tailoring in the garments industry.

*Lodge-based sex trade:* About 5% of the USWs are based in motels (commonly known as lodges in India), renting out rooms on a permanent basis.

*Brothel-based sex trade:* The remaining 5% of the USWs are based in brothel buildings in residential areas. Brothels keep changing locations, for fear of suspicion among neighbors or the police.

USWs are vulnerable to several social, economic, and health issues. Many USWs are affected by poverty (especially those earning in the range of INR50-200 or USD1-4 per client). Poverty manifests as other issues: condoms are not enforced on male clients since they agree to pay more for “going natural”. Condoms are also telltale signs if discovered by the police, resulting in harassment. This results in HIV and other STIs. Violence is pronounced in these communities: police, pimps, intimate partners, or *goondas* (thugs) may abuse the USWs and extricate a major share of their earnings. Not surprisingly, many USWs turn to alcohol during work, resulting in further tensions.

*Legality:* The Immoral Traffic (Prevention) Act or PITA is a 1986 amendment of legislation passed in 1956 to prevent illegal trafficking [3]. While it is illegal to operate brothels and surrounding activities in India, it is not illegal to exchange sex for money. A sex worker can be punished for soliciting or seducing in public, while clients can be punished for sexual activity in proximity to a public place. In reality, sex work in India lies in a grey zone, under police enforcement and pimp discretion.

### **USW vignettes**

We present two vignettes to illustrate the everyday life of urban sex workers. We pick two types from the general typology—home- and street-based—since they represent majority of the USWs at 90%. Both cases are chosen to be representative of the two types.

Lakshmi is a 45-year old home-based USW. She is a mother of 3 adult children, who are all married. Originally from the Mandya district of the Karnataka state, she is a native Kannada speaker who has lived in Bangalore since her marriage. Lakshmi has not attended school. Her husband’s alcohol addiction drove her into the trade at 35 years of age. She was introduced by her female friend (also a sex worker) to a client. Among friends and family, she maintains an image of a garment-factory worker, working a day-shift between 9 am to 6 pm. Lakshmi rents out a room in the neighborhood where she solicits, usually on one of the busy streets. Her earnings vary between zero to INR 1,000 (~USD 21) per day, after servicing multiple clients.

Her professional mobile phone is strictly switched off and hidden in her purse when she is home. She distributes her mobile number to her clients, encouraging them to pass it around. She shares her other phone freely with her family. This phone is used as a mobile landline at home, and also functions as radio.

Jaya is a 25-year old street-based USW. She was introduced to this line of work at age 19, when she left her family in rural Hosur. She dropped out of school in 5<sup>th</sup> grade. Her first contact in the city of Bangalore was a female USW, who then initiated her into the trade. Jaya is unmarried. She practices sex work at night, between 10 pm and 7 am. Her usual solicitation spots are in and around the Bangalore city bus terminal. She rents out a room throughout the night at a motel near the terminal. She sleeps during the day, usually at the local Pragati drop-in shelter or at her friend's place. Jaya earns anywhere between zero to INR 500 (~USD 11) per night; a huge portion of the earnings are distributed among the local police and her intimate partner. She sends another portion of her earnings to her family in Hosur, who believe she works as domestic help. Jaya owns a dual-SIM mobile phone, switching numbers when she visits her family. Her mobile phone is her nodal point in everyday communications and in soliciting customers: she uses the same phone to make calls to her tailor and milkman, as well as intimate partner and clients. Despite being non-literate, she gets her friends to store address book contacts, and rote-memorizes names through symbolic literacy [15]. The phone is strictly "cleansed" when she takes it to her village, as she sometimes reverts to her old SIM for everyday telecommunication, but rejects calls from any clients.

## DESIGN SPACE

### Potential application areas

From our ethnographic observations, we found that Pragati's communication ecology was prone to several problems: the Jeevikas were unable to always reach out to the USWs because of their busy work schedules and scattered lifestyles. Large-scale communication took several days to transpire. Communicating an urgent message to all members instantly was next to impossible.

For the services provided by Pragati, the USWs tended to forget the dates for monthly HIV and STI medical tests. Several STIs are non-symptomatic, which pose severe problems when undetected. Members would discontinue their treatment upon success from the first dosage (for example, syphilis requires three Penicillin shots, but the women stop at the first shot, which is ineffective at curing the disease). Another problem area was that of microfinance monthly payments for loans. With compounding interest, missing the deadline for a repayment can be costly, given the poverty-stricken conditions of USWs. Consequences for missing a deadline include ineligibility for loan requests for the following two months.

Mobile phone penetration among Pragati USWs is self-reported by Pragati administrators at 97%, which is an

unusually high number for both: a developing nation population (the average wireless tele-density in India is 55.14% as of July, 2010 [1] and women (who are 37% less likely to own a mobile phone in South Asia, as of February, 2010 [4]). Mobile phones are excellent tools for reminders and announcements, since they form a pervasive infrastructure, are very effective at delivering short messages, and are portable. For the above-mentioned problem areas, we took into consideration the exceedingly high mobile penetration among USWs and narrowed down on designing a reminder and announcement system. USWs lead busy and nomadic lives; therefore, the system seemed better poised at sending short, effective messages rather than behavior change through sex education or financial literacy. We picked two areas—microfinance and healthcare reminders—as focal points for our system.

### Design constraints

Designing a system for USWs entails dealing with unique lifestyles. We generated a socio-cultural analysis that highlighted possible dimensions where our design response needed to be particularly sensitive. We list them below:

*Multiple devices:* While the USWs we met were exceptionally technology-reliant, there are other challenges to consider with such perpetual usage. A salient finding from our ethnographic observations is that the maintenance of multiple identities follows that multiple mobile phone identities are maintained, for work and for family. This could mean either two separate devices, or dual-SIM phones. Work phones are strictly switched off and hidden at home; however, there is some seepage at times.

In addition, mobile phones are heavily prone to theft and misplacement. It is estimated by Pragati that roughly 2-3% of their USWs lose their phones per month. Moreover, mobile numbers are constantly changed for a variety of reasons, such as purchase of a new phone, avoiding contact with partners or pimps, or circumvention of suspicion.

*Invisibility:* Many USWs lead double lives, maintaining different images, stories, and logics at work and home. Identities switch, information does not flow, and networks are disconnected, across infrastructures. Work identities are protected from the family. Boundaries are established between the legal and illicit, not as forgery, but as a necessary occupational measure. How do we think about fuzzy properties in technology design?

Associated with the invisibility realm are several issues that have implications for technology design. There is a stigma of being attached to formal institutions for fear of identification. Within the Pragati project, there is a common binding thread (sex work) and mechanisms are in place to verify the reputation of a member before formal transactions, like loans. How can we create a trustworthy system that will carefully balance existing relations with the NGO and remain sensitive to the nature of the USW work, not jeopardizing their lives?

*Migration and scatteredness:* Most USWs are migrants from villages and towns in Karnataka and neighboring states. Mobility is a prime part of the street-based USW lifestyle; many of them live out of a suitcase. It is common for USWs to leave with their partners for several days at a stretch, or travel to where their work takes them.

Unlike populations that cohere through shared spaces, such as neighbors, street-based USWs are either homeless or scattered across the city. There is a pronounced lack of social capital that is built from sharing a geographical space. This poses a challenge for accountability for institutional transactions.

*Timing:* Home-based USWs operate at regular hours, similar to day jobs (as part of their story of working as domestic help or seamstresses). Street-based workers usually operate at night, and rest during the day. Consequences of intervening at an inappropriate time, hence in an inappropriate geographical space can include revealing protected identities. Due to the flexible working hours and nebulous times when sex work is actually carried out, timing is a crucial in designing for USWs.

## SYSTEM DESIGN

As a design response to the problem of reaching out to the USWs, we designed, implemented, and began evaluations on a phone-based broadcasting system. It was designed to call several mobile phones at once, and play audio messages upon feedback from the receiver.

We were interested in porting a mass-media approach over to a device that is, in some ways, designed more around mutually-accepted coordination and exchange than one-way large-scale dissemination, and in understanding its effects.

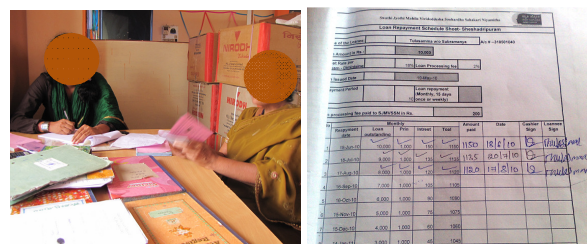
### Design process

We employed human-centered, ethnographic action-research in the design of our system. We integrated our initial ethnographic findings into the system design. We deployed the system between July–September 2010, for various application areas that we will note in the next section. We constantly sought feedback from our users and iteratively revised the features. Jeevikas and Jananis helped us gather phone numbers of their members, for our phone system. We also transcribed paper-based microfinance and health records into our database (see fig. 1).

In the current setup, the Jeevikas and Jananis go out to the field and act as communication agents between Pragati and the members, i.e., a person-to-person model. Implicit in this setup is a high level of trust in field staff and Pragati. Our system was not meant to be a replacement for the current communication processes; in fact, we wanted to leverage the actors in the loop and the trust placed in them. In the next sub-section, we discuss the various design criteria that we chose from our study results.

### Design criteria:

*Build a phone-based, server-side infrastructure:* Owing to



**Figure 1. (Left) Field interviews with USWs and (right) microfinance bank records.**

the ubiquity of mobile phones, our system was envisioned to work on telephones. In order to avoid compatibility issues and potentially incriminating application traces, we decided to build a server-side infrastructure.

*Leverage audio:* Our system would solely make use of audio messages, to avoid literacy issues and make use of the familiar oral format. Text messages were another possibility, but they rely on literacy.

*Leverage institutional trust:* One of our key motivations in building the system was to leverage the existing institutional and interpersonal trust. We recorded audio messages using the voice of the friendly Field Coordinator of Zone 3, who was a highly visible and much-liked person. This ensured that our content was approved by Pragati.

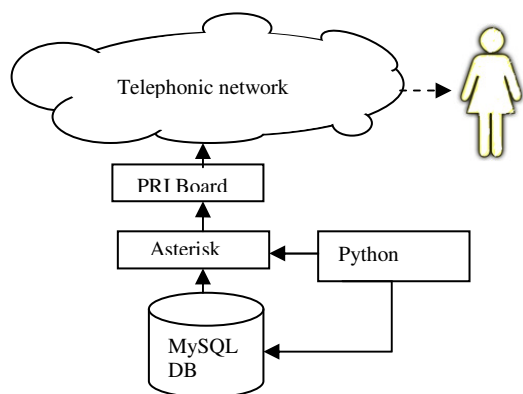
*Keep the calls short:* We wanted to keep the audio messages short, hoping that it would interfere less with the USWs' lives as well as motivate listening to the content end-to-end. We decided to intersperse the voice content with classical music in the background.

*Keep the content anonymous:* In our attempts to respect the privacy of the USWs, we decided to make the content non-linked to the receiver and not divulge identifying or criminalizing information, such as names, sex work, or HIV records, while still being clear to the recipient what the message was about.

*Find a good time to call:* Based on the overlap between street- and home-based USWs, we decided to broadcast the audio messages at late afternoon-evening. During these timings, home-based workers solicit and street-based workers relax or get ready for their night shifts.

**Implementation:** We built a broadcasting system using off-the-shelf components and custom scripting. We used Asterisk [5], an open-source telephony software, on Linux to make the outgoing calls. We utilized a Primary Rate Interface board (2000 Media Series from Dialogic, Inc.) to allow up to 15 phone calls in parallel. We wrote Python scripts to automatically generate call files from a phone number input log, and to dial the numbers in parallel. The system played pre-recorded audio messages upon hearing any feedback noise from the receiver side. We produced audio as 8 KHz, 8-bit Pulse Code Modulation wav files.

The system enabled simple logging of the outcome of each call, including whether it was answered, time of dialing,



**Figure 2. System architecture.**

and the total duration of each call. Organizations can easily adapt the system by supplying their own audio recording and list of telephone numbers to call; the rest is automatic.

## DEPLOYMENT

For our deployment, we chose four applications areas, depending upon the purpose, scale of phone numbers, nature of communication, and relation to existing information sources (standalone or complementary to field workers). Table 1 explains the breakdown of our deployments. Table 2 explains their results.

Our system was designed to serve as an effective broadcast communication system. Towards this, we were interested in understanding the following: the percentage of the population that was reachable; the effect of timing on reachability; and the percentage of the reached population that listened to the content entirely. We were looking for behavior change to whatever extent possible, but were acutely aware of our time limitation of three months. We used a mixed-method approach to understand how, what, why, and when the system intervened into the USWs' lives.

*Structured interviews:* We conducted interviews both in person and over the telephone after each deployment. In-person interviews were conducted at Swati Manne premises. Interviews over the phone were sufficiently modified to respect privacy of informants. We asked for the person's name from our phone database, and then revealed our identity if the person confirmed that it was indeed the right person. Our interviews probed into the information ecology, call context, mobile phone profiling, reactions to the call and audio, and the after-effects of the call.

Deployment	Target	Nature of communication	Stand-alone?
<b>Pilot: Swati Manne inauguration</b>	Selected #s, one-time (n=35)	Reminder	No
<b>Microfinance loans</b>	Loanees with #s, one-time (n=23)	Reminder	No
<b>HIV testing</b>	All numbers, one-time (n=230)	Advertisement	No
<b>Computer training session</b>	All numbers, twice (n=627 in total)	Announcement	Yes

**Table 1. Breakdown of deployments.**

*Data records:* We collected and transcribed medical and financial records from Pragati. As a baseline, we analyzed the financial health (i.e., their average rate of repayment, days before or after deadline, outstanding amount, length of the loan period, etc.) and created portfolio profiles for the members (reasons why they borrowed the money, typology of sex work, and neighborhood). For the medical tests, we analyzed the frequency of testing.

*Phone logs:* Finally, we monitored and analyzed the master call log maintained by Asterisk. Here we looked for duration of listening to the voice messages, number of calls that were answered, and the time of dialing.

**Swati Manne Inauguration:** In July 2010, Pragati was opening a new Swati Manne in zone 3. A cultural program was organized, which included *pujas* (worship), talks, and lunch. Our system was deployed alongside traditional communication methods of face-to-face announcements, by Jeevikas and Jananis. We collected the phone numbers of 35 USWs through Jeevikas and Jananis.

For the content, we recorded the voice of the zone 3 field coordinator. We faced several challenges in this simple task. We recorded the message at the Swati Manne premises, to fit with the schedule of the Field Coordinator. However, the environment was prone to perpetual and random background noise, such as auto-rickshaw and bus horns, metro rail construction, and the regular buzz at Swati Manne. We overcame this issue through a combination of noise removal, voice amplification, and background music.

Another design challenge was to keep the message succinct and clear. We avoided talking about the organization or motivate the members about the event explicitly. Our recorded message was follows: "Namaskaram [Greetings]. My name is Geetha, and I am calling from Swati Manne, Zone 3. We

	Swati Manne inauguration reminders	Microfinance loan reminders	Medical testing advertisements	Computer training announcements
<b>Members</b>	35	38	230	627
<b>Members w/#</b>	35	23	230	627
<b>% Reachable members</b>	NA	61.00%	NA	NA
<b>Connected calls</b>	29	22	207	441
<b>Finished content</b>	27	20	121	354
<b>% Finished/Connected calls</b>	93.10%	90.90%	58.54%	80.27%
<b>% Connected calls/Members w/#</b>	82.85%	95.65%	90.00%	70.33%
<b>Audio message length</b>	19 seconds	13.2 seconds (average)	31 seconds	15 seconds

**Table 2: Summary of results from the four deployments.**



**Figure 3. Swati Manne inauguration.**

are shifting our old Swati Manne to Rajaji Nagar. The inauguration program is tomorrow at 11 am. Lunch will be served. I request you to kindly attend. Thank you.”

**Results:** Of the 35 members we contacted, 29 calls were answered (table 2). 5 phones were switched off. Twenty-seven members (93.10%) listened to the entire audio.

Ten out of 29 contacted attended the event, out of which 5 had not heard through field workers. 9/10 people reported distrust in foreign and male voices and several interviewees liked the short length of our messages (at 19 seconds). Many members were traveling or soliciting at the time of receiving the call.

**Microfinance reminders:** Our second deployment was targeted at loanees of *Swathi Jyothi*, the microfinance (MFI) wing of Pragati. Individual loans are taken out for mortgage, children’s education, starting new part-time businesses and so in. Built on a joint liability model, 3-4 members get together and form a group. While the members do not have to save to form a group pool, they commit themselves to repay each other’s loans, should there be any defaulting by other members of the group. Failure to repay on time also means that loanees cannot request loans for the next two months. Our interviews reflected some confusion among the USWs in recalling their loan deadlines, attributable to their non-literacy and lack of financial visibility.

“The [loan] dates keep changing each month and I often forget when the repayment is. Some days I barely make anything, so paying the fine is an additional problem.”

We were motivated to modify the broadcasting system to send out reminders for deadlines. We collected as many phone numbers of loanees as possible (23 out of 38 loanees) from *Swathi Jyothi*, the MFI at Pragati. We sent out reminders one day before the deadline. The voice message conveyed that a payment was due on the specified deadline. We did not include names of the loanees in the messages.

**Results:** Twenty-two out of 23 members were reachable, out of which 20 members (91%) listened to the content entirely. In general, we found no difference between payment rates of members who got the call (payment on

	Avg. # of months	Avg. # months on time (%)	Avg. # of days paid on time (days)	Avg. # on time in August (%)	Avg. # of days paid on time in Aug (days)
Call	4.7	86.78	-1.66	77.27	0.23
No	5.4	87.65	-1.99	77.77	-0.88

**Table 3. Analysis of financial portfolios.** (Avg. # of months is length of loan so far & avg. # days is number of days paid before deadline, negative for early, positive for late payments)

time = 77.77%) and the 15 who did not (payment on time = 77.27%). Two women that we had called were hospitalized after HIV and one USW’s grandmother had passed away, which brought down the overall average by 16, 17, and 7 days each. Without these 3 loanees, the average payment with calls was made 1.59 days in advance, compared to 0.88 days in advance without the call. However, our interview findings unanimously indicated that the microfinance reminders were useful at reminding loanees:

“I have a slip of paper on which the due dates are written, but I often forget to pay with all the tension at work and home. I have been paying late for the past 3 months. This call really reminded me to pay on time.”

Another interviewee spoke of how the system helped her remember without incurring a due.

“I was in the Ghati Subramanya temple for a worship. I got this call and I immediately took the bus back to Bangalore to pay my fees, since I had forgotten by then. I remembered the amount, not the exact date. I was very happy to get the phone call.”

However, payments are a function of availability of funds. Interviewees noted that reminder calls one-two days in advance were sufficient, re-affirming our design decisions.

**Medical testing reminders:** Our third deployment was focused on sending out medical testing advertisements to the USWs. Pragati encourages HIV and Syphilis testing once every 1-3 months, depending upon the volume of sex work and age of the USW. From our interviews with Pragati staff, it was noted that they found it difficult to remind the women about their tests, since the dates varied each month and there was a general lack of interest in getting tested. We sent out advertisements to motivate the USWs to attend the medical examinations. We were interested in understanding whether the calls were reaching out. Note that this phase targeted all Pragati members of zone 3 whose numbers were collected.

For the audio message, we were faced with the challenge of including content that would communicate in a relevant and appropriate fashion, but at the same time, not reveal details about HIV or other STIs or risky information. In consultation with the Pragati staff, we decided to model the content similar to radio advertisements promoting medical examinations. Our message read as follows:

“Namaskaram, I am Geetha speaking from Swathi Mahila Sangha. We are organizing healthcare camps. They will be conducted at the following locations: every Sunday at the Leprosy hospital, every Wednesday at Swati Manne, every Thursday at the Kamkshi Pallaya government hospital, every Friday at the Ayurvedic

	Friday	Monday
Members w/ #	297	330
Connected calls	122	319
% Connected calls /Members w/ #	41.07%	96.66%
Finished content	106	248
% Finished/Connected calls	86.88%	77.74%

**Table 4. Results of Friday and Monday announcements.**

hospital, and every Saturday at the Kamala Nagar BBMP hospital. We will conduct blood tests and health examinations. Please attend without fail. Thank you.”

*Results:* Out of the 230 numbers contacted, 207 connections were made (90%). One hundred twenty one members listened to the content in entirety (59%). Note that the audio for this deployment was longer and more detailed compared to other phases, at 31 seconds. The content was not targeted at any individual in particular, and medical testing was only recommended, not compulsory. Not surprisingly, the listenership dropped slightly, compared to other phases.

“I think the reminders are a very good thing. But I am perfectly healthy. I use condoms with clients 100%. Why should I go get tested? Why go through the pain when I know I am okay?”

**Computer training:** For our final deployment, we made use of the broadcasting system to make announcements about a free computer training session arranged by us. These announcements were made solely via the system. Our motivation in this field trial was to explore the possibility of a phone-only information source and to make the announcements a few days prior to the event. For the event on Tuesday, we called the Pragati members of zone 3 on the preceding Friday and Monday of the week. Our audio message included details on the event, including time, location, and lunch.

*Results:* For the computer training, we initiated two sets of announcements on two days (on Friday and the following Monday) (see table 4). The numbers called on Monday were the same 297 as those on Friday with 33 additional numbers for a total of 330. In fact, on Friday 87% of those reached listened to the message entirely. Since Friday and Monday calling were cascading events, there was some repetition between Friday users and Monday users (hence the lower listenership on Monday). Of the total number calls dialed, 63 people (19%) attended the training.

We provided basic computer skills training, printed material and lunch. For the training, our modules included MS-Word, MS-Paint, MS-Excel, and YouTube. Except for one person, no one had touched a computer before. All participants indicated that they found the session to be useful. Even though the training lasted the afternoon, we later discovered that several USWs showed up after the training was over, because of their schedules.

## FINDINGS

Overall, our results indicate that the broadcasting system is effective at reaching out to members with phones and delivering content: we connected with 85.25% of members



**Figure 4. Computer training deployment.**

who provided phone numbers. 80.7% members listened entirely. We notice that short, interesting messages got across (88.09% listened entirely on average for phases 1, 2, and 4, of 12.73 seconds average) and detailed messages got hung up on sooner (58.54% listened for 31 seconds in phase 3), amidst subject material, day/time of call, and being the first call received versus a later call received. The system was widely accepted by Pragati staff and USWs, attributing to its non-intrusiveness and minimal time requirement on part of staff in recording, and users in listening.

Our deployments over multiple “development verticals” are relatively rare in HCI4D; we were keen on learning about the nature of the unsolicited broadcasts across healthcare, microfinance, and training.

## Reactions to unknown numbers

One of our main findings was the mixed reaction to getting calls from an unknown phone number (i.e., from our outgoing number). From our ethnographic interviews, we had learned that mobile phones are key instruments in contacting customers. However, not all USWs distributed their professional phone numbers to their clients. Therefore, not all women were used to getting calls from unknown numbers (albeit the occasional wrong number) regularly.

First-time reactions to our calls were a combination of curiosity and doubt. Interestingly, from our interviews, we learned that several USWs would call either the zone 3 Pragati office or their local point of contact (Jeevikas or Jananis monitoring them), despite the fact that the number was that of our research unit. With subsequent calls, they had learned to recognize the number as one associated with Pragati. We expected users to show less interest in listenership with time. However, the later deployments reflect that while the percentage of reachable connections was still high (SD: 10.92% across deployments), the percentage that actually finished the content varied (SD: 15.80%). We learned that this number depended on content (relevance and interesting-ness) and institutional affinity.

## Trust

Using the field coordinator’s voice invoked positive responses. Our system was amplified by the familiarity and



trust built by the Pragati staff, over years of working the USWs, in its reach and authenticity.

“If not for the voice of madam, I would not be sure. We know her and respect her. If it were someone else, I would be really suspicious. I took the message seriously only because of madam.”

Taking a cue from large advertising campaigns, we initially thought that using the voice of film stars or popular personalities may be more effective in getting the message across. However, given the sensitive nature of the content, we found a strong proclivity towards using a female voice.

“Since the messages were about health and money, if it were a male voice or a film star’s voice, then I will be really suspicious because the content is so sensitive.”

This quote suggests that popular voices may actually be counter-productive—a trusted, well-recognized voice works better for sensitive material. Using Geetha’s voice also gave the impression to the members that they were “taken care of” (in the words of a Swati Jyothi cashier). Another interesting finding is that several members mistook the automated recording to be a live transmission. Even though our system sent out broadcasts, the findings are a strong indicator of how members reach back to Pragati. This is only possible because of the previously established foundation of relationships.

Anchoring with the NGO helped us not only augment their own reach to their members, but also made our system more acceptable and in sync with established practices.

#### **Timing rhythms and control**

One of our initial concerns in designing the system was that of being sensitive to various social infrastructures, such as home and work. Our members unanimously voiced that the system was effective at reaching out to them, without any side-effects. Since the users themselves had agency in controlling their technology usage, by switching off phones when not at work or rejecting the calls, the connections that were established were non-perilous to their lives. Such control has implications for the fraction that is actually reachable, despite the ubiquitous mobile phone penetration.

One way to counter the timing issue is to call on different days, as evidenced in our computer training calls. For the computer training calls, on the Friday, we reached 41.07% users (122/297 calls), whereas on Monday, we reached out to 96.66% (319/330 users), even though we called during the same time slot of 3 – 5 pm. Added to this, several mobile numbers were non-functional. A viable solution here may be for the user to register herself, if she gets a new SIM, perhaps by providing a missed call to the number.

#### **Diffusion**

USWs present a unique case of multiple devices per person. In addition to reaching out to individual members through their mobile phones, we noticed a diffusion effect among other members. Several interviewees noted that they called their friends to convey the message. Such a diffusion effect helped surpass actual technology penetration through a social infrastructure, as also noted in [15]. Indeed, for the

computer training event, 5 of the 68 who attended did not receive the call and had heard about it through other means.

“I called my friends in my group [joint-liability group] when I got the call about the loans. I called my close friends when I got the call about the computer training. This [system] is very useful to us. It helps me learn about important events over the phone itself. I did not want my friends to miss out on such useful events or forget to pay their loans. It will earn us a bad reputation if we forget.”

Our interviews indicate that heavy diffusion occurred among the USWs for the pilot and microfinance deployments. In two cases, 2 women who did not receive calls had made loan payments upon being reminded by their group member who received the call. Three women who attended the Swati Manne inauguration were persuaded by their friend, for whom the call legitimized the event.

“After getting the call, I thought it was an important event for our community to attend. I convinced my three friends to come.”

### **DISCUSSION**

What can the design of a broadcasting system for USWs teach us about designing systems for other vulnerable or nervous populations with similar design constraints, or even Mobiles for Development (M4D) in general?

#### **Challenges for ubiquity**

Due to their far-reaching penetration, mobile phones are met with great optimism by designers of technologies for the developing world, especially in the M4D space [8]. However, design in the developing world is not simple; mobiles neither always constitute neat one-to-one, private use configurations [15], nor are they being shared freely all the time. Their use is determined by complex, socio-economic negotiations. USWs’ use of mobile phones at home and work highlight some of these tensions.

Mobile connections are unambiguously based on the user’s own terms. Mobile phones exist across several social infrastructures. The challenge is to make the applications relevant within each socio-technical system, yet meaningful across these infrastructures. In our case, it was often critical that information remained siloed for different contexts. Women work very hard to keep their work secret from their families, and their use of phones reflects this segregation of communication. Privacy, trust, and timing issues are not unique to USW communities. While mobile phones transcend many facets of people’s lives, some boundaries may be permeable, but others need to remain fixed. Failure to respect these boundaries can be dangerous and potentially detrimental to the users.

#### **Caveats in shared-use models**

Prior research has underscored the important role of shared use in developing communities, as seen in [6,16]. Indeed, in our study, we see that sharing is not necessarily a defining, normative, practice within the socio-cultural milieu of USWs. While the USWs share within certain realms and social groups, like home and family, tight control is exhibited when they do not wish to share: for example,

family members are not allowed to pick up their work phones, by making them invisible. Contrary to the obvious, economic challenges do not always drive shared technology usage in poor communities, as we see how USWs are very poor yet technologically well-connected; as a counterpoint to the expansion of reach through intermediated, shared access in other communities [15]. Such caveats emphasize the need for further work in sharing, such as [18].

### Phone numbers and identities

Phone numbers are increasingly used as identities, such as in mobile Internet [8] and mobile banking [10]. Our study alerts us to several challenges in using mobile numbers as identities, such as timing and permanence. Mobile phones are fluid and ever-changing. In the case of USWs, they are explicitly forked for a separate identity. Moreover, phones are easily lost or numbers are changed. Our deployments point to the fact that a synchronous, broadcasting system such as ours simply cannot reach all users, unlike e-mail, voicemail, or asynchronous, stored mechanisms, leaving us looking for a middle-ground. Using mobiles as intervention channels for vulnerable, migrant, untrackable or low-literate populations, where the mobile is the only personal communication device, requires designers to carefully balance approachability, permanence, and identity.

Unlike the technical view of identity or privacy management in the western world, where the technology is a proxy to the construction of identity, we see that identity and privacy around mobile devices in the developing world are socially-negotiated [16]. Users run up against the system in forging their identity and privacy. They adopt specific strategies in coping with their identities, not dissimilar from teenagers coping with privacy, victims of domestic violence, people managing sexual or other controversial lifestyle choices, or those seeking confidential medical information such as HIV or psychiatric problems.

### CONCLUSION

In this paper, we presented the design of a phone-based broadcasting system and the results of our deployment at an NGO catering to urban sex workers. We articulated the challenges in designing for USWs and the organizational constraints in reaching out to them. We presented the results of four deployments of the system, in sending out reminders, advertisements, and announcements.

USWs present a severe case of problems that plague the developing world, such as poverty, health concerns and social marginalization. Yet they also represent a unique demographic for high technology penetration, multiple devices per person, and intensive usage in their everyday practices. While the developing world is not yet saturated by technology or concerned with technology-mediated privacy yet, it is likely that various user groups will meet some of these issues sooner or later. Looking explicitly into the design concerns for such groups may pave the way for designing new technological interventions for a variety of

at-risk populations where mobiles are the only personal communication device available.

### ACKNOWLEDGMENTS

Our thanks to Pragati staff and members for sharing their life stories with us in a heartfelt and welcoming way. We thank our anonymous reviewers and AC for their thoughtful comments. We also thank Paige Bills, Ruy Cervantes, Jonathan Donner, David Hutchful, Chinmay Kulkarni, Bonnie Nardi, Navkar, Praveen, Nimmi Rangaswamy, Aishwarya Ratan, and Bill Thies.

### REFERENCES

1. TRAI. <http://www.trai.gov.in/>.
2. Around 2.8 mn prostitutes in India. <http://expressindia.com/news/fullstory.php?newsid=86159>.
3. Human Rights Reports: India. <http://www.state.gov/g/drl/rls/hrrpt/2008/sca/119134.htm>.
4. Vital Wave: Emerging Markets. <http://www.vitalwaveconsulting.com/insights/articles/AsteriskProject>. <http://www.asterisk.org/>.
5. Burrell, J. Evaluating Shared Access: social equality and the circulation of mobile phones in rural Uganda. *CMC*. 15, 2 (2010), 230-250.
7. Cervantes, R. and Sambasivan, N. VoiceList: user-driven telephone-based audio content. In *Proc. MobileHCI 2008*, 499-500.
8. Gitau, S., Marsden, G., and Donner, J. After access: challenges facing mobile-only internet users in the developing world. In *Proc. CHI 2010*, 2603-2606.
9. Hashim, M.J., Franks, P., and Fiscella, K. Effectiveness of telephone reminders in improving rate of appointments at an outpatient clinic. *Am. Brd. of Fam. Med.* 14, 3 (2001), 193.
10. Hughes, N. and Lonie, S. M-PESA: Mobile Money for the "Unbanked". *Innovations: 2007 2*, 1-2 (2007), 63-81.
11. Le Dantec, C.A. and Edwards, W.K. The view from the trenches: Organization, power, and technology at two nonprofit homeless outreach centers. In *Proc. CSCW 2008*, 589-598.
12. Parikh, T.S. Engineering rural development. *Comm. of ACM* 52, 1 (2009), 54-63.
13. Patel, N., Chittamuru, D., Jain, A., Dave, P., and Parikh, T.S. Avaaj Otalo: a field study of an interactive voice forum for small farmers in rural India. In *Proc. CHI 2010*, 733-742.
14. Puccio, J.A., Belzer, M., Olson, J., et al. The use of cell phone reminder calls for assisting HIV-infected adolescents and young adults to adhere to highly active antiretroviral therapy. *AIDS Pat. Care & STDs* 20, 6 (2006), 438-444.
15. Sambasivan, N., Cutrell, E., Toyama, K., and Nardi, B. Intermediated technology use in developing communities. In *Proc. CHI 2010*, 2583-2592.
16. Sambasivan, N., Rangaswamy, N., Cutrell, E., and Nardi, B. UbiComp4D: infrastructure and interaction for international development. In *Proc. UBICOMP 2009*, 155-164.
17. Sherwani, J., Ali, N., Mirza, S., et al. Healthline: Speech-based access to health information by low-literate users. In *Proc. ACM/IEEE ICTD 2007*, 131-139.
18. Steenson, M. and Donner, J. Beyond the personal and private: Modes of mobile phone sharing in urban India. In *The Reconstruction of Space and Time (Vol. 1)*. Piscataway, NJ: Transaction Books, 2009, 231-250.
19. Tanke, E.D. and Leirer, V.O. Automated Telephone Reminders in TB Care. *Medical Care* 32, 4 (1994), 380-389.