

Research Article

User-Generated Content Creation and Dissemination in Rural Areas

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Abstract

A majority of the world's population does not have access to the Internet. Therefore, there is a need for a simple and affordable interaction technology that can enable easy content creation and dissemination for this population. In this paper, we present the design, development, and usage pattern of a VoiKiosk system that provides a voice-based kiosk solution for people in rural areas. This system is accessible by phone and thus meets the affordability and low-literacy requirements. We present usability results gathered from usage by more than 6,000 villagers during nine months of the field deployment of the system. The field experiments and post-pilot feedback suggest the importance of locally-created content in their own language for this population. The system provides interesting insights about the manner in which this community can create and manage information. Based on the use of the system in the nine months, the VoiKiosk also suggests a mechanism to enable social networking for the rural population.

Introduction

The total rural population, as of 2005, was about 51% worldwide. If we look at less-developed nations, then this number is even larger, at 57%, which translates to more than 3 billion people. For India, the percentage of rural population is even higher—71%. Based on United Nations Development Programme projections (UNDP, 2007), this number is not likely to change quickly in the coming years (the percentage yearly change from rural to urban is projected to be around 1%). Even so, most human-computer interaction (HCI) research has been focused on interaction with *computers*, machines to which this population does not have access. Therefore, it is extremely interesting to look at sections of this large population base and identify the information and communication needs, as well as the means to achieve these needs, and to study the interaction modalities of this society.

A majority of this 71% rural population in India is illiterate, or at least textually-illiterate (India Budget, 2002). This means that, though they can count currency and make phone calls using numbers, their ability to read or write is very limited. The means of interaction of this society is either completely voice-based or paper-based. Some people (especially the money lenders and shopkeepers) make paper notes of their business. Most people (such as farmers) interact using voice, getting information through radio, television, and other public announcement methods in villages. Newspapers continue to be another source of accessing information.

However, the common problem across these information sources for



Figure 1. Announcement of a government-organized health camp.

these villagers is the lack of *locally relevant* content. Most newspapers, radio, and television programs provide information that caters to a wider segment of the population, thus leaving out the details for specific villages. One of the common methods for providing local information (such as health-related warnings) is to make announcements using loud-speakers on vehicles. Figure 1 shows one such vehicle being used by a government healthcare official to announce an upcoming health camp in the village.

There is a paucity of information sources that can create sufficient locally relevant content, such as news of doctor visits organized by the government, changes in school timings, delays of the train service, lists of movies in the village community, etc. If there were a system that could enable this community to create its own content, the information and communication ecosystem could be significantly improved.

Since not much has been studied about the rural population, to build an information system that can be used by the rural population to create and access content, it is extremely important to follow these design steps:

1. *Identify the information needs of this population.* It is important to understand what

a community considers important information. To enable easy access of information, a meaningful categorization is also needed.

2. *Follow a participatory design process to develop a low-cost, low-literacy solution.* Since a majority of this rural population in India lives on less than US\$2 per day (PRB, 2006), it is important that the solution be affordable. Moreover, the low-literacy considerations also need to be taken into account when developing the end-user interface of this system. A participatory design process is important to study a population that has not been exposed to interaction modalities beyond paper, radio, and TV.
3. *Observe usage patterns of the solution for the rural population.* Since little research has been performed on enabling local content creation, usage patterns of this population will be interesting to observe, and they might provide important insights.
4. *Get explicit feedback from people about usefulness and usability of the system.* It is important to get end-user feedback, as from it, we can come to understand the usability of the system and the usefulness of the content to the rural population.

In this paper, we follow these four principles to build VoiKiosk—a system for increasing reachability of information kiosks in developing regions. A VoiKiosk is a voice-based service available on the Telecom network (Agarwal et al., 2008). As opposed to PCs, the phone penetration in rural India has been significant, and it continues to grow. Also, based on field studies and literature reviews, semi-literate and illiterate people are more comfortable with speech-based interfaces to access information services (Parikh & Lazowska, 2006). Leveraging the increased mobile penetration and the general comfort with speech-based interfaces, we present this alternate model to create and host voice-based

kiosks (VoiKiosks). While we realize that economic sustainability (and therefore, a business model) is a key for ensuring large-scale adoption of a solution, we consider this aspect to be beyond the scope of this paper.

We identified the information needs of villagers in the south of India by visiting several villages and talking to villagers and officials of an NGO that has operated in these villages for more than seven years. Based on the needs we found, we implemented the VoiKiosk system and involved a limited number of users and the NGO in the participatory design phase. We deployed the system live in one village and gathered important usage statistics through nine months of live field deployment. We performed a survey with a feedback questionnaire, reaching more than 600 participants, and we present some interesting results from this survey. We conclude the paper by discussing important insights gained during the entire process of needs-gathering, participatory design, prototype testing, and usage analysis.

Related Work

Several studies have suggested that rural communities have very different information and communication needs and patterns (Sheshagiri, Sagar, & Joshi, 2007; Kolko, Rose, & Johnson, 2007). Moreover, it has also been noted that technological innovation opportunities in rural areas have not been studied in great depth (Ramachandran et al., 2007). In that paper, the authors present field studies suggesting that the use of a local stakeholder contributes significantly to achieving better designs of technologies for rural communities. While there are significant design challenges for the rural community, at the same time, the potential for technology to improve the rural population's lifestyle is huge (Pralhad, 2004). This forms the motivation for the work presented in this paper.

A. Information Access and Dissemination

In the current world of globalization, access to information is key to the development of a society (Brynjolfsson & Hitt, 1996). The increasing amount of information on the Internet (Netcraft, 2010) is a reflection of this fact. Not surprisingly, therefore, there have been several efforts to provide this information to people in rural areas. There are solutions in the network space to provide low-cost Internet access for rural areas (Matthee et al., 2007; Saif et al., 2007). Significant work has also been done on

improving the usability of mobile Internet interaction. Buchanan et al. (2001) highlight the various usability issues by studying critical comments by mobile Internet users. Despite all these solutions, the usefulness of Internet information for people in developing countries is very limited, since the content that is relevant for a villager is not available on the Internet (Heeks, 2002). This paper positions itself in the space of creation and dissemination of locally-relevant content and is supportive of the following statement: Access to **relevant** information is key to the development of a society.

B. Alternate Models for Local Information Systems

Community radio systems have been studied as an alternative solution to provide information in rural areas. Megwa (2007) presents a study that evaluates the effectiveness of 10 community radio stations in different rural communities in South Africa and reports the popularity of programs. A sustainability study of the community radio service is presented in Hussain and Tongia's (2007) paper on Nepalese radio stations. Extensions to community radio service to involve audience participation have been presented by Sterling, O'Brien, and Bennett (2007). Among other things, the success of community radio lies in the availability of relevant content for the rural communities. The CAM system (Parikh, 2007) provides an interface to capture local data using the mobile phone camera. It has been applied for microfinance data capture (Parikh et al., 2006), and for procurement and quality control in a rural cooperative (Schwartzman & Parikh, 2007). Using a camera phone to capture paper content is another approach to creating local content. We derive the importance of *relevant content* presented in the cited works, and we use these concepts in this paper.

C. Speech- and Mobile-Based Systems for Low-literacy Users

Since textual literacy is a major issue in developing countries, especially in rural areas, several interesting information systems for this community are speech-based. The community radio systems mentioned beforehand are completely based on audio information. Studies on a spoken dialog system for rural India (Plauche & Prabaker, 2006) show that users are able to navigate the dialog system, irrespective of their literacy levels. A speech-based system for providing health information to low-literate users has

been presented in Sherwani et al. (2007). This paper reports the need to educate users by creating a video to explain the system to a new user.

Information systems based on low-end mobile devices provide an affordable alternative to PC-based systems. A system for providing information to farmers using mobiles has been presented Veeraraghavan, Yasodhar, and Toyama (2007). Kolko et al. (2007) conclude that exploring mobile social software holds significant potential as an information tool in rural areas. The MobileD (MobileD, 2010) and the AudioWiki (Lienonen, Aucamp, & Sari, 2006) are recent solutions that address this space by providing information to this population through mobile devices.

The work presented in this section leads us to believe that creation and dissemination of *locally-relevant content* through *speech interface* using *mobile devices* can be used as an effective system to provide for the information needs of the rural population in developing countries. System-level technology development work in this domain has been presented in Kumar et al. (2007) and Agarwal et al. (2007), where the authors present technologies for content creation and linking. A solution based on these technologies (Kumar et al., 2008) proposes to organize the unorganized urban poor businesses. In this paper, we extend the concepts of the World Wide Telecom Web (Kumar et al., 2007) and apply them to the provision of information solutions to the rural population in developing countries.

Needs Survey

In order to understand the information needs of a community, it is important to know the community for a significantly long time. Selective interviews are often restrictive, and they may not provide the deep insights that can be gained with time. An understanding of the community's working and living methods can either be learned through an extensive ethnography study, or by learning from the experience of organizations that have done such study and have a presence in the community (Ramachandran et al., 2007). We relied on the latter approach. This was one of the reasons for us to choose villages in the Andhra Pradesh state, which is in the southern part of India.

A. The NGO Operations in the Field

Byrraju Foundation (Byrraju, 2010) is an NGO that operates in 198 villages in six different districts of

Andhra Pradesh. The NGO has performed detailed studies to identify the needs of the villagers from a much broader perspective. Their operations cover basic amenities, such as sanitation, drinking-water, and healthcare, as well as advanced services, such as distance education, remote healthcare, and rural BPOs. The following are the main activities of the NGO in these villages:

- **Education:** The NGO adopts one primary and one secondary government school in every village. They provide training to teachers, conduct distance education courses, and provide health check-ups for students.
- **Healthcare:** There is a health center in every village where a doctor spends two hours daily. The Village Coordination Officer (explained later) acts as an assistant to the doctor. There is an ambulance service for all the villages.
- **Sanitation:** The NGO has facilitated a garbage collection system for all the villages. The garbage collector generates and sells manure from the garbage to make the system self-sustainable. Drinking-water plants have been set up in some villages, providing door-delivery of water at 10 paise per liter (US\$0.0025 cents per gallon).
- **Ashwini Centers:** 20 villages have computer centers. These are used to provide distance education to students during school hours. Later, they are used to provide painting and embroidery classes to women.
- **Agriculture/Aquaculture Advice:** Experts in distant locations provide personal advice to agri/aqua farmers based on the crop/fish conditions.

The NGO has a Village Coordination Officer (VCO) for every village. A VCO is usually a woman who has had 12 years of formal education. The VCO can only understand the local language, Telugu. For every three to five villages, the NGO has positioned a Nodal Coordination Officer (NCO) to oversee activities in these villages. The NCO can understand English and holds a degree in some subject. The NCO can operate the computer. Every village has a Gram Vikas Samitee (GVS), a committee of 18 members from the village who have volunteered to work with the NGO on the 18 different modules.

Table 1. Summary of information needs in four villages.

Village	Population	Households	Mobiles	Main operators	DTMF	Will pay?	Information	Remarks
Vandaram	2,292	450	150	Airtel/ BSNL/ Idea/ Vodafone	No preference	Depends on value of information. Not initially.	Program schedule of Ashwini, Information categorized on Modules, Pesticides, Medicines, Aquaculture information, sports updates, railway inquiry.	Yes for pilot.
Juvvula Palam	3,800	850	600	Airtel/ Tata/ BSNL/ Vodafone	Voice is better	Depends on value of information. Not initially.	Community news, Agriculture information, No to train, No to electricity, Doctor visit, Teleconferencing information announcement, Panchayat meetings, Ankur channel program schedule. Hub village for 400,000 population in nearby villages.	Yes for pilot.
Cherukumilli	4,047	1,000	500	Airtel/Idea	Voice	After realizing the value, they may. Not initially.	Information about village, Panchayat meetings, GVS meetings	
Ibhimvaram	4,600		3,000	Idea/Airtel	Voice	Yes	Tractor renting, Electricians, Panchayat meeting, National fish rates, V-agri	GVS very interested for pilot.

B. Needs Gathering in the Field

We visited four villages, accompanied by the NGO field staff, to understand the information needs of this community. The NGO staff provided the development history and details of the community for these villages. These four villages were identified based on their varying demographics to get a broader perspective. The first village, Vandram, has agriculture as its main source of livelihood, and paddy is the main crop. Juvvala Palam is one of the larger villages; it is geographically located as the central hub for the population of nearly 400,000 in nearby villages. This village has a large population base that deals with renting transport vehicles, so the associated businesses of mechanics and drivers are also very common.

The third village, Cherukumilli, is primarily aquaculture-based, and it has a number of fish ponds where aqua-farmers cultivate fish. Ibhimavaram is a very wealthy village where farmers have large tracts of land and usually employ laborers to cultivate their farms. Except for Cherukumilli, all the other three villages had a computer center (called an Ashwini Center). Table 1 summarizes the important inputs gathered in the field. Most people preferred to interact with the system through voice, as opposed to DTMF (Dual Tone Multiple Frequency, or touch-tone keypad input), as is shown in the table.

Each meeting in a village was with the GVS committee head, the NCO, the VCO, and some members of the GVS committee of that village, all in one room. Most villagers share a phone within their family. Thus, the cell phone penetration rates are more than 50%, considering the number of families that have a cell phone. Ibhimavaram has 100% cell phone penetration. Privacy of contacts or calls is not a concern in this open community. This culture enables easy sharing of cell phones between family and friends. Almost all villagers mentioned that the mode of interaction with the cell phone device is voice. People do not use text messaging, even though this is relatively cheaper. All cell phones have Roman letter inscriptions, and there is no local language support, either on the keypad or on the screen. All cell phone users are number-literate and can recognize Arabic digits. However, very few people can understand the Roman script for alphabet characters.

The cellular signal is sufficiently strong in all

remote areas. Although there are many electricity blackouts, these intervals are short in duration; thus, difficulty with charging cell phones is not an issue. There are two major service providers (Airtel, BSNL), however, there are about five different service providers available.

Most officials and village committee members mentioned that people would be interested in knowing several schedule-related pieces of information, such as distance education class schedules, village committee meeting schedules, and minutes from those meetings. Other information needs were based on agriculture information, community news, and crop rates. In Juvvala Palam, people were interested in knowing about electricians, mechanics, and different rental options for farming equipment. Except for in Ibhimavaram, other villagers mentioned that, while the villagers may not pay for the service initially, once they could see value from the information, they would have the capacity to pay for the information.

Based on these meetings, we identified the following categories of information which is required by villagers:

- *V-Agri*: Provide agriculture and aquaculture advice to farmers on cell phones
- *Job work*: Items and type required by merchants so that villagers can get business
- *Availability of transport*
- *Health*: Mostly static information, such as doctor schedules or dates for the eye camp or the student camp
- *Aqua prices*: Traders can upload the prices at which they will purchase fish or prawns
- *People*: Static information about electricians, mechanics, etc., with phone numbers
- *Entertainment*: Names of movies in the nearby theater
- *Ashwini program schedule*
- *General information about the village*: Population, availability of health center, schools, etc.
- *Community news*: GVS meeting schedules, meeting minutes, sports achievements, etc.

It was clear from the field interactions that a phone-based information portal that enables interaction through voice would be ideal from the end users' perspective. Such a system would ensure that

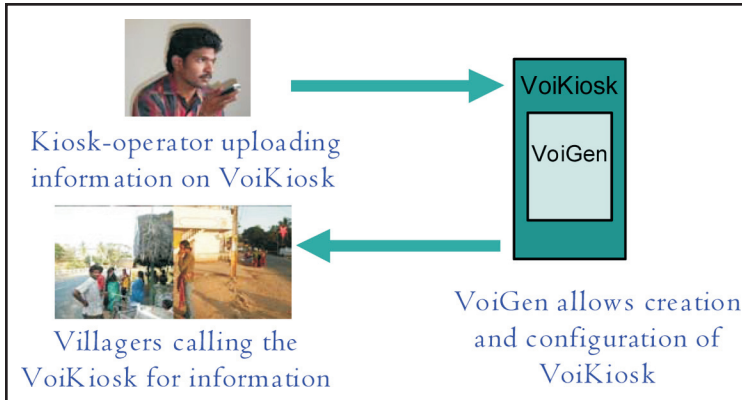


Figure 2. VoiKiosk usage scenario.

the end users would not need to learn any new interaction modality, nor a new device. Given the significant cell phone penetration, a cell phone-based system could be used to fulfill the information needs of these villages.

Prototype Implementation and Testing

Of the 10 different categories of information identified in the previous section, we built a prototype of the VoiKiosk system for four main categories. A VoiKiosk is a specific instance of a VoiceSite that can be used by villagers to create and access locally-relevant content. A VoiceSite can be thought of as something parallel to a Web site, but which can be accessed by dialing a phone number rather than by requesting a URL, and where information can be listened to rather than being read or seen. Creation of a VoiceSite is made easy by the VoiGen system (Kumar, 2007), which anyone can call up and interact with through voice. This can enable any illiterate person to create her own VoiceSite. Such a system enables easy local-content creation. All information in the VoiceSite is stored as audio messages that are recorded by making a phone call to the system.

Since a VoiKiosk is a VoiceSite for the entire village, different types of users can update content in different sections. We explain the types of users and their interaction with the VoiKiosk in the next section. The kiosk operator (typically an NCO or a VCO) navigates through the VoiKiosk application to configure it to offer various services for the village.

Figure 2 shows a sample operational scenario for the VoiKiosk.

A VoiKiosk acts as an information and service portal for a village. It can be a central point of access for a community, a place where information relevant to the community can be posted and accessed directly by the users themselves. This solution doesn't rely on Internet connectivity, which is most often not available in the rural areas, and most importantly, it allows end users to interact directly with the services, thus removing the dependence

on the kiosk operator.

The following are the four main categories of information available on the deployed VoiKiosk system for the village:

- **V-Agri:** Farmers use this service to consult agriculture experts regarding their crop-related problems. Currently, a picture of the crop is taken and sent to an expert, who then sends a reply back to the farmer through the foundation. The turnaround time for this process is 24 hours. With VoiKiosk, the expert is able to post his advice for the farmer on the VoiKiosk, reducing the turnaround time to four hours. VoiKiosk identifies farmers based on their caller IDs.
- **Health Information:** Information related to different health advisories and health camps is posted on the VoiKiosk. The schedule of doctor visits to the health center is also posted on the VoiKiosk. The VCO can change the message if there is a change in the doctor's visitation schedule.
- **Ashwini Center Schedule:** Information regarding new programs, a schedule of daily classes, or changes in the schedule are advertised by word-of-mouth, local newspapers, or posters that are pasted at various spots in the village. Often, people go to the Ashwini Centers to get this information in person. The VoiKiosk has an Ashwini Center section where a kiosk operator can post the latest news related to the distance education program.

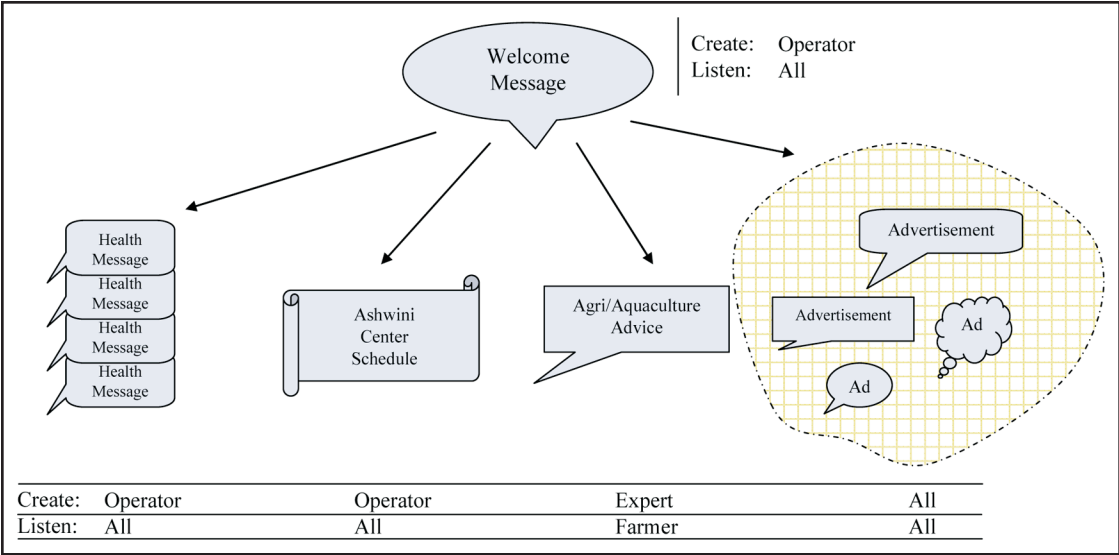


Figure 3. Information on VoiKiosk: Categories and access rights.

• *Professional Services:* In this section, users can record their personal advertisements. In the current practice, micro-businesses such as those run by mechanics, drivers, and daily-wage skilled laborers use word-of-mouth advertising to reach out to clients. VoiKiosk provides an opportunity for these micro-entrepreneurs to increase both their client base and business opportunities for themselves. Users call the VoiKiosk and record their advertisement, which other villagers can then browse by calling the VoiKiosk.

As shown in Figure 3, the information in these four categories can be modified by different kinds of users. All information is accessible to everyone, except for the expert advice, which is specific to a particular farmer. We discuss the different types of users in more detail in the next section.

The call-flow for a specific interaction of the kiosk operator with the VoiKiosk is shown in Figure 4. The kiosk operator can choose either to modify the welcome message for the VoiKiosk system, or to modify information in any of the four different categories. Within a category, the operator is allowed to create a new information message, delete any existing message, or re-record an existing message. All the options selected by the user are processed through voice recognition of the specific keywords.

Participatory Design of the VoiKiosk System

Given the four categories of information, based on the creator and the consumer of this information, there are four types of users of VoiKiosk system users:

- *The kiosk operator* has the permission to modify any content on the VoiKiosk. He can call the VoiKiosk from his cell phone, and the system will identify his caller-ID and provide the right permissions.
- *Experts* are allowed to post expert comments on agriculture and aquaculture for specific farmers. They dial the phone number of the farmer for whom they have to post a message. Experts cannot post comments in any other category.
- *Farmers* call into the system to listen to any message from the experts. They can listen to information in other categories, as well.
- *Villagers* can post an advertisement or listen to any other general information in the VoiKiosk.

A kiosk operator, who acts as an administrator, is usually identified for the VoiKiosk. The kiosk operator has permission to add different categories, as well as to add or delete information in any category.

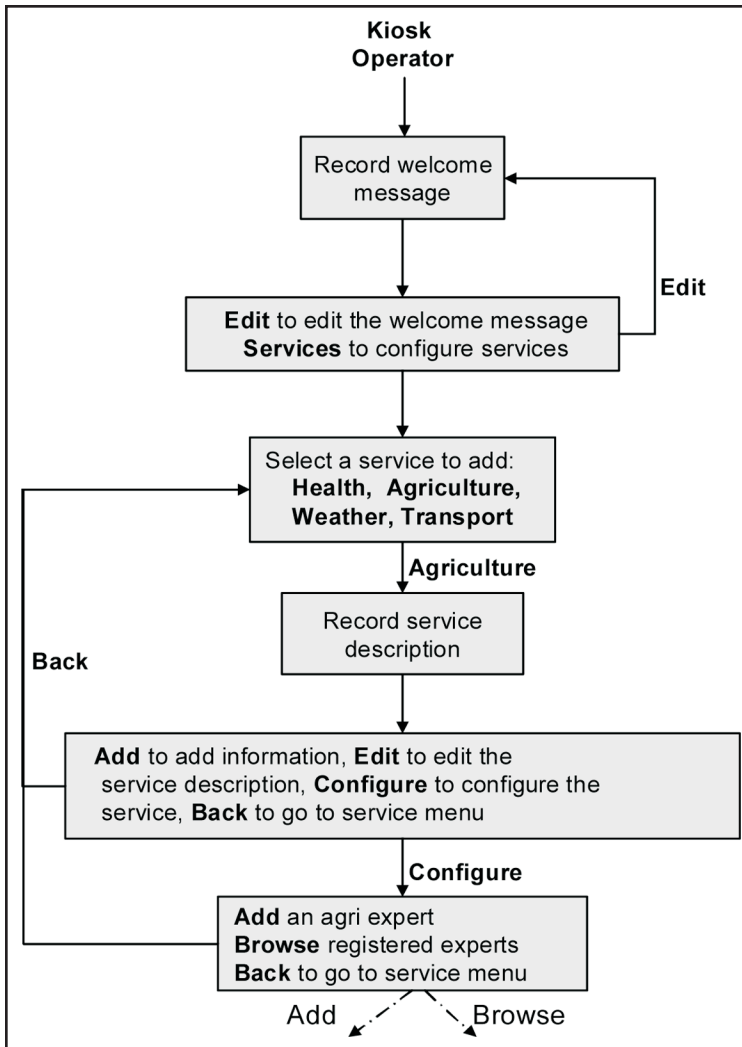


Figure 4. Kiosk operator call flow.

We have developed a kiosk template for a group of villages in Andhra Pradesh.

A. Participatory Design Modifications

We developed the prototype system in consultation with the NGO and then took it to the field to get feedback from the four types of end users. Since the kiosk operator has the maximum number of options available on the VoiKiosk, we started our testing with two kiosk operators. The initial design of the system was such that, when the system expected a user input, there would be a beep sound at the end of the system utterance. However, the beep sound was present only when the system was used to

record user voice; not when the system would perform speech recognition of the voice. Since this fact was unknown to the users, they did not know when to start speaking. Sometimes, they would respond too early, and other times, they were too late. This resulted in increased frustration, so, to make sure that they were speaking during the interval when the system would accept their input, they kept on repeating the same utterance, such as "exit, exit, exit." We modified the VoiKiosk interface such that, after every system input, there was now a "beep" sound. The users could then figure out that they were always supposed to wait for a beep before responding. This improved the system performance significantly.

There was a system prompt that asked the following of the users: "Do you want information on health or agriculture or the Ashwini Center Schedule, or do you want to know about the people in this village?" We expected that people would respond by saying either Health, Agriculture, Ashwini Center, or People. However, the users answered Yes or No. So, we had to change the prompt to "Please

say 'health' for health-related information, or say 'agriculture' for . . ." Although these descriptive prompts are too lengthy and not as natural, this community preferred to listen to prompts that clearly told the user what to say. This was a very good insight from these participatory design experiments. Users in villages have more patience and prefer simple, descriptive system prompts to more natural-sounding prompts. Perhaps the cognitive load on the users is less if they are told what all they can say to the system.

From the expert's perspective, they wanted any advice that they posted to the farmers to also be archived in the NGO IT infrastructure. The NGO



Figure 5. Initial prototype testing with the farmers.

believed that this database of specific advice might be able to act as a knowledge resource in the future. We created an FTP site so that all the content in the V-Agri section would be pushed to the NGO server at midnight. The duration of any message to be posted on the VoiKiosk was restricted to 10 seconds in the initial design of the system. The system automatically detects silence and identifies the end of the utterance. However, if there is some noise in the background, then the system is not able to detect the silence, and the message recording continues. This can result in user frustration, both during message recording and at the time of listening. The other option was to ask the users to press a specific key to explicitly let the system mark the end of the utterance. But this would involve a key input, which we wanted to minimize, given the profile of target users. So, we had fixed the duration to 10 seconds. However, this duration was too short to record some of the experts' messages. Since experts were more advanced users in terms of the device familiarity, they could use the keypad while talking over the phone. So, we increased the duration to 30 seconds for the experts. They now have to press the # key if there is background noise to indicate the end of the utterance.

The participatory design process improved the system significantly. With the first version of the system, the kiosk operator used to take about 10 minutes to reach the Ashwini Center part of the

VoiKiosk and then update a message. Now it takes him (and any novice user) less than two minutes to update a message.

Participatory Design of VoiKiosk System

The VoiKiosk was tested with the villagers for a period of nine months. We present the usage statistics of the VoiKiosk system by analyzing the data through two approaches. The first approach presents the analysis by looking at the data as a whole. This analysis is presented to demonstrate the increasing acceptability of the VoiKiosk system in the village. In the second

approach, we present the results against the backdrop of the changes that were made to the system over time. This will provide more details about the effects these changes had on the usability of the system by improving interactions. In this section, we will present the two results in more detail.

A. User Background and Village Demographics

The pilot was deployed for villagers in the Juvvala Palam village in South India. This village has a population of about 4,000 people that form about 850 families. About 70% of these families have a cell phone. The male/female ratio is 100:94 in this village. The main occupation of this village is agriculture, and paddy is the dominant crop.

Transportation is the main business for this village. People rent their trucks, tractors, and smaller vehicles for a few days to people in nearby villages. These are used by farmers in their fields, or for a specific social function, such as a wedding. The village has a health center, where the doctor visits for two hours every day. There is one bank in the village, where about 10% of the families have a bank account. The average monthly income for a family is roughly 2000 rupees (US\$50). All cell phone users are comfortable dialing numbers and talking with other people. However, the level of text-messaging is very low. As a rough estimate, only about 10% of villagers use text-messages for communicating via cell phones. This is because the local language

Table 2. Summary of different sections visited by users.

Description	Number	Percentage
Agriculture	13,326	18.9%
Health	13,693	19.5%
Ashwini Center	8,078	11.5%
Advertisements	35,253	50.1%

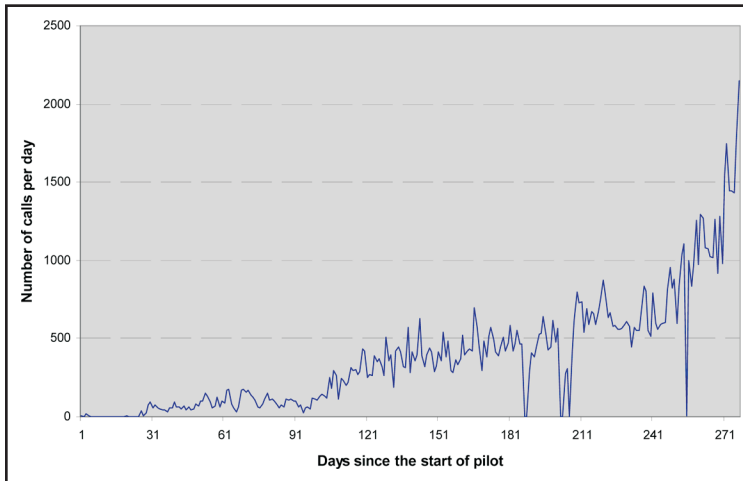


Figure 6. Number of calls per day, starting from the launch of pilot.

(Telugu) is not supported on the device, and since only about 20% of people know limited English, text-messaging is almost non-existent.

The village has a secondary school and a primary school. The NGO facilitates English and math classes through a distance education program in these schools. The NGO also facilitates distance education in MS Office, spoken English, embroidery, and painting classes for adults. Villagers from Juvvala Palam participated in the pilot.

B. Overall System Usage

The VoiKiosk system was live, 24 hours a day, seven days a week, for nine months. In these nine months, the system received a total of 114,782 calls from 6,509 villagers. We assume that a unique phone number would map to a specific villager's phone, because the trace to users is based on the caller identification in the VoiKiosk system. Table 2 shows the number of calls that went to the different services in the VoiKiosk. The ad section of the VoiKiosk was accessed the highest number of times. The third

column in Table 2 shows the percentage of the total number of calls that accessed this service. Since this number does not add to 100, not every call accessed a service.

Users spent a total of 2,135 hours on the VoiKiosk system. The average call time was 74 seconds, with a maximum of 49 minutes and minimum of zero seconds. The number of calls increased steadily from the pilot launch date. The graph in Figure 6 hints at the increased acceptance of the VoiKiosk system over time. On average, while there were about 50 calls per day at

the start of the pilot, the last week of the pilot witnessed more than 2,000 calls a day.

An interesting thing to note is that the NGO did not actively train the villagers to use the system, nor did they advertise this service aggressively. We had started with a group of about 30 users who were initially contacted to start using the system and provide us with feedback. The caller base increased from these 30 users just by word-of-mouth, and even reached the neighboring villages. Villagers from the neighboring villages called to create their ads on the VoiKiosk.

While most calls were during the afternoon and late evening times, we were surprised to see calls arriving at 2:00 A.M. There were a total of 13,955 calls received between the odd hours of 11:00 P.M. and 5:00 A.M. Figure 7 shows the calling pattern during various times of the day. This is an aggregate number of the total calls in the nine months of the pilot. There were a total of 13,159 ads recorded by 2,338 different users. Many people re-recorded their ad multiple times over the period of nine months.

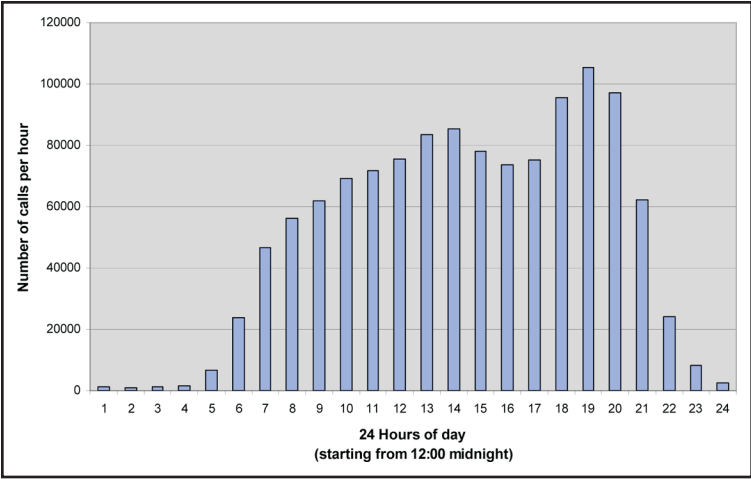


Figure 7. Hourly breakup of number of calls in the day.

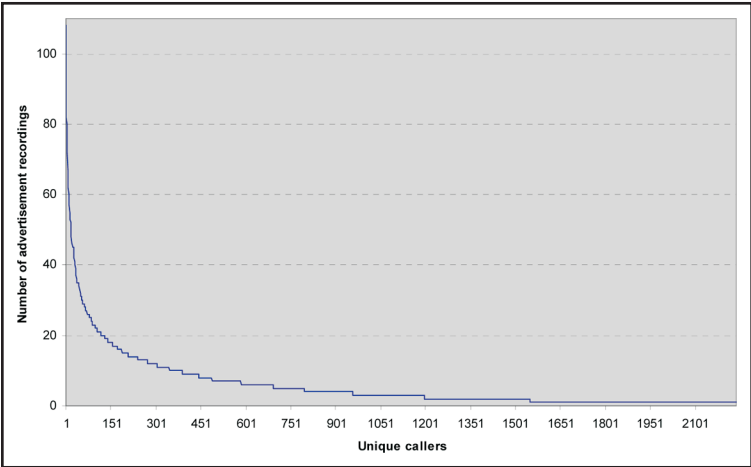


Figure 8. Advertisement update frequency of callers.

Although one person can only record one ad, people often call again, either to improve their ad, or to record a fresh one. One caller had recorded his ad 62 times. Most callers had recorded the ad only once. The graph in Figure 8 shows the different callers and the number of times they have recorded their ads.

C. Improvements with Changes in Interface

During the nine months of the live pilot, we made two changes to the system:

- 1) Enabled easy navigation of advertisements by providing options to jump to the next ad through keypad input.

- 2) Enabled easy recording of advertisements by allowing users to record without them having to listen to any other ad.

The initial system was live for 70 days. After the first change, the system was live in that form for 21 days. After the second change, it was live for the remaining 128 days. Table 3 shows the number of calls, average call time, and number of ads, as well as the number of unique callers in the three situations. Over the period of nine months, the number of advertisements increased. Despite that increase, due to improved navigation, the time spent by users has not increased significantly. In the first deployment of the system, a caller had to listen to all the ads before she could post her own. The reason behind this was that, by listening to the ads, a novice user would know what to speak in her own ad. When the number of advertisements increased beyond 20, we noticed that the users were still patiently listening to them, and then would post theirs.

This usage pattern provides (at least) one of the following two insights about the users:

- This population is more patient and could listen to a longer list of information over phone than what has been observed with the Western population's experience with spoken dialog systems.

And/Or

- The villagers ascribe certain value to posting an advertisement, so they are ready to wait for a long time in order to get a chance to post.

When the number of ads increased beyond about 40, we provided an option to jump to the next ad by pressing a key on the phone keypad. Perhaps the users were comfortable with navigating

Table 3. Change in VoiKiosk Usage with System Change. Initial System is the first version that was deployed. Modification-1 is the system that enabled navigation of advertisements. Modification-2 allowed easy recording of Question and Choices advertisements.

System state	No. of calls	Average time	Unique callers
Initial system	6,239	79 sec	335
Modification-1	4,437	104 sec	227
Modification-2	104,106	74 sec	6,509

the VoiKiosk system by then, and therefore they were able to learn the keypad navigation. It should be noted that, at this point during the needs-gathering phase, the users had clearly mentioned that navigation through keypad interaction would not be easy, so a speech input method should be provided to navigate the VoiKiosk. Even then, the average time spent per call was higher (104 seconds) after *Modification-1*; it reduced to 74 seconds when we provided the option to record without users having to listen to all advertisements. This is a clear insight that *users were able to interact more efficiently with the VoiKiosk system when we provided keypad-based shortcuts for faster navigation.*

Feedback Survey

At the end of the nine-month pilot, we conducted a survey of the VoiKiosk system. The process of conducting the survey itself was novel. Any person who would call the VoiKiosk system would first get to listen to the survey question, and only then were they able to access the content on the VoiKiosk system. Since the number of questions was limited to six, and the callers would have to answer them just once, the process was not too intrusive. The process of conducting the survey is, itself, a good indication that such a system could be used to collect important statistics in a rural community—without actually having to visit the remote areas. The following were the quantitative questions asked in the survey:

- Why did you advertise on this toll-free number?
- Were you comfortable in recording the ad?
- Who else uses this toll-free number from your phone?
- What do you like most about the toll-free system?
- How did you learn to use the system?

The callers were presented with specific choices to answer each question, which made these questions answerable in a quantitative way. Table 4 summarizes the responses received from 657 participants.

When we designed the ad section of the VoiKiosk, the assumption was that people would use this to advertise their work so that they could get more business. But as the results above indicate, villagers were extremely interested in being heard in a public community forum. Forty percent of people uploaded the advertisements because their friends/families asked them to, an indication of the strong social network in the community. This social network helped the 30% of the people who had problems with the usability of the system in the initial stages. Only 20% of the people surveyed mentioned that the system was not easy to use. Since this was not an open-ended, interactive survey, we could not get the specific problem details from this segment of users. Another aspect of the social connection that is reflected in the usage of the VoiKiosk is the sharing of phones to access it. More than 50% of the callers had lent their phone to their friends and families. The last question, about the learnability of the system, again supports the fact that the social network can be put to effective use for helping in the system usability.

In the introduction to this article, we mentioned that there was a lack of locally relevant content for rural areas. This was supported by the fact that about 74% of subjects responded that VoiKiosk was useful in providing them information about their own village. Having done the survey on the VoiKiosk, we realized that the usefulness of VoiKiosk also lay in performing data collection remotely. Such data collection exercises are typical of many governments and organizations. The ability of people to answer these questions on the VoiKiosk is an additional indication of the ease of use of the interac-

Table 4. Survey responses from 657 villagers.

Question and Choices	Response Percentage
Why did you advertise?	
<i>I wanted to speak out.</i>	44.4%
<i>Someone asked me to try it.</i>	40.8%
<i>It could help my business.</i>	14.8%
Were you comfortable posting your ad?	
<i>Very easy to use.</i>	49%
<i>Initially it was a problem.</i>	30.3%
<i>Is not easy to use.</i>	20.7%
Who else accesses the system from your phone?	
<i>Only me.</i>	45.2%
<i>My friends.</i>	37.9%
<i>My family members.</i>	16.9%
What do you like the most about this system?	
<i>It is easy to get information about my villagers.</i>	74%
<i>I could create my own advertisement.</i>	26%
How did you learn to use the system?	
<i>Someone helped me initially.</i>	63.2%
<i>On my own.</i>	36.8%

tion, if the content is relevant and local. It would have been interesting to discover the details behind some of these questionnaire answers through detailed interviews with some of the villagers, but we do not have that information.

Discussion

The ad section attracted the most attention, and it was accessed the most. Initially, we had a couple of users (a mechanic and a truck owner) upload personal (classified-type) ads to the VoiKiosk. Despite these initial, straightforward examples, the villagers soon found some very interesting and innovative uses for this section:

- An eighth-grade student announced himself and his mobile number.
- A man uploaded his profile for matrimonial purposes (to invite marriage proposals). He made several attempts until he was satisfied that all the details he wanted to capture were recorded.

- Another person created a “response ad” commenting on the above profile!
- A pair of young parents recorded a message in their child’s voice for the child’s grandparents to hear.
- A politician posted a thank-you message after winning a local election.

These examples are very demonstrative of several things: a) the villagers really understood the technology enough to play with it and find innovative uses for it; b) even though they may have never heard of social networking on the Internet, the need for social networking is natural and compelling; and c) they independently discovered the message/response-to-message interface, as well as voice mail (as obvious as these might sound to us). *Thus, the ad section evolved into a message-board through innovative use of the interface by the villagers.*

As was mentioned in the previous section, in an earlier incarnation of the VoiKiosk, a villager had to listen to all the advertisements before posting his own, but that did not seem to present a deterrent.

The villagers appear to be extremely patient in listening to all the information and spending a lot of time with the system, which may be a reflection of culture, or of the lack of alternatives, most likely both.

Of the 114,782 calls received on the VoiKiosk system, only 13,157 were for creating the content. Of these, 9,287 advertisements were posted on the system. The remaining calls of content creation perhaps did not result in user-satisfactory recordings, so the content was not posted by the users. Creating the content in the VoiKiosk either occurs by way of a villager recording an advertisement, or by the recording of other messages by the kiosk operator or the agriculture expert. Therefore, more than 88% of the calls were for accessing the content on the VoiKiosk system, while only about 12% of the calls were made for creating the content. *This indicates the usefulness of the content that was being created on the VoiceSite.*

In the previous section, we provided more details about the advertisements than about agriculture, health, or the Ashwini Centers, because the other three categories were mostly information uploaded from one specific person (either the kiosk operator or expert), and the access was to villagers. Therefore, these services, although important, were different from advertisements, because the latter had *user-generated content*. By providing the ability for all to create content, VoiKiosk becomes a much more participatory platform.

Although statistical analysis proves the acceptance of the VoiKiosk system by villagers, the next step is to get usability feedback directly from the users. We plan to talk to a sample of VoiKiosk users and seek their feedback regarding the system's usability and the value of content. We also plan to provide more critical services through the VoiKiosk system, such as daily crop price notifications made to registered farmers, or medication reminders made to patients. It will also be interesting to observe the usage pattern of a new village, note the similarities and differences, and argue whether they reflect the demographics of that village.

Conclusion

In this article, we present an information kiosk system to create and access locally relevant content for use in rural areas. We identified the information needs in rural areas by talking to villagers and a

heavily involved NGO. We developed VoiKiosk—a voice-based system that can be accessed by a phone—to provide a cost-effective solution that is easy to use for the less-literate people in rural areas. We tested the initial prototype with the villagers to evolve a participatory design of the final system. The system was then deployed live in a village in India, and we captured user statistics for nine months. More than 6,500 users used the system over this period. Those users made more than 100,000 calls to the VoiKiosk system. We presented the usage pattern obtained by different modifications in the VoiKiosk over the nine months of the data-capture. We provided a detailed description of how some of the services were used beyond what they were designed for. This leads us to an interesting insight into the social networking applicability of the VoiKiosk system.

The increasing use of the VoiKiosk system for different purposes leads us to believe that a voice-based mechanism for local content creation is a very powerful interaction modality to provide information and communication technologies in rural areas. ■

Acknowledgment

We thank the Byrraju Foundation for supporting VoiKiosk in Andhra Pradesh villages, and for providing valuable insights.

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