Content Creation and Dissemination by-and-for Users in Rural Areas

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Abstract—**83% of the world population does not have access to 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 900 villagers during four month of the on-field deployment of the system.**

The on-field experiments 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 four months, the VoiKiosk also suggests a mechanism to enable social networking for the rural population.

I. INTRODUCTION

The total rural population in 2005 is 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 the projections in [1], this number is not likely to change fast in the coming years (the percentage yearly change from rural to urban is projected to be around 1%). Even so, most of the HCI research has been focussed on the interaction with *computers*, 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, the means to achieve these needs, and study the interaction modalities of this society.

A majority of this 71% of rural population in India is illiterate or at least textually-illiterate [2]. Therefore though they can count currency and make phone calls using numbers, the 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 (esp. the money lenders, shopkeepers) make paper notes of their business. Most people (such as farmers) interact using voice, and get information through radio, television and other public announcement methods in villages. News papers continue to be another source of accessing information.

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

Fig. 1. Announcement of a government organised health camp.

There is a lack of enough information sources that can create sufficient locally relevant content such as doctor visit organised by the government, change in school timings, delay of the train service, list of movies in the village community, etc. If there is a system that can enable this community to create their own content, the information and communication ecosystem can be significantly improved.

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

1) *Perform a needs-study to identify the information needs of this population.* It is important to understand what does a community consider as information. To enable easy access of information, a meaningful categorisation 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 below USD 2 per day [3], it

is important that the solution is affordable. Moreover, the low literacy considerations also need to be taken in developing the end-user interface of this system. 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 pattern of the solution for the rural population*. Since not much research has been performed in enabling local content creation, the usage pattern of this population will be interesting to observe and can provide important insights.

In this paper, we follow these three principals 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 [4]. As opposed to PCs, the phone penetration in rural India has been significant and 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 [5]. Leveraging the increased mobile penetration and comfort with speech based interfaces, we present this alternate model to create and host voice-based kiosks (VoiKiosks).

We identify the information needs of villagers (Section III) in south of India by visiting several villages and talking to villagers and officials of an NGO that operates in these villages for more than seven years. Based on the needs, we implement the VoiKiosk system (Section IV) and involve a limited number of users and the NGO (Section V) in the participatory design phase. We deploy the system live in one village and gather important usage statistics by four months of live field deployment of the system (Section VI). We conclude the paper by discussing important insights gained during the entire process of needs-gathering, participatory design, prototype testing and usage analysis.

II. RELATED WORK

Several studies have suggested that rural communities have very different information and communication needs and patterns [6] [7]. Moreover, it has also been studied that technological innovation opportunities in rural areas have not been studied in great depth [8]. In [8], the authors present field studies suggesting that use of a local stakeholder contributes significantly to a better design of the technologies for rural communities. While there are significant design challenges for the rural community, at the same time, the potential of technology to improve their lifestyle is huge [9]. 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* [10]. The increasing amount of information on the WWW [11] 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 access for rural areas [12], [13]. Significant work has

also been done on improving the usability for mobile Internet interaction. In [14], the authors highlight the various usability issues by studying the different critical comments by mobile Internet users. Despite all these solutions, the usefulness of Internet information for people in developing countries is very limited due to the fact that the content that is relevant for a villager is not available on the Internet [15]. This paper positions itself in the space of creation and dissemination of locally relevant content and is supportive of the 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 a alternative solution to provide information in rural areas. In [16], the authors present a study that evaluates the effectiveness of 10 community radio stations in different rural communities in South Africa and report the popularity of programs. A sustainability study of the community radio service is presented in [17] for Nepalese radio stations. Extensions to community radio service to involve audience participation have been presented in [18]. Among other things, the success of community radio lies in the availability of **relevant** content for the rural communities.

The CAM system [19] provides an interface to capture local data using the mobile phone camera. It has been applied for microfinance data capture [20] and for procurement and quality control in a rural cooperative [21]. Using camera phone to capture paper content is another approach to create local content that can be used in several application domains. We derive the importance of *relevant content* presented in the cited work and 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 above are completely based on audio information. Studies from a spoken dialog system for rural India [22] 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 [23]. This paper reports that there is a need to educate the users by creating a video to explain and demonstrate the system for 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 in [24]. The authors in [7] conclude that exploring mobile social software holds significant potential as an information tool in rural areas. The MobilED [25] and the AudioWiki [26] 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 information needs of the rural population in developing countries. System level technology development work in this domain has been presented in [27] and [28] where the authors present technologies for content creation and linking. A solution based on these technologies [29] proposes to organize the unorganized urban poor businesses. In this paper, we extend the concepts of the World Wide Telecom Web [30] and apply them for providing information solutions to the rural population in developing countries.

III. 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 may not provide deep insights that can be gained with time. The understanding of the working and living methods can either be learned through an extensive ethnography study or by learning from experience of organizations who have done such study and have a presence in the community [8]. We relied on the latter approach. This was one of the reasons for us choose villages in the Andhra Pradesh state in southern part of India.

A. The NGO Operations in the Field

Byrraju Foundation [31] is an NGO that has been operating in 198 villages in 6 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 at one end to advanced services such as distance-education, remote-healthcare and rural BPOs. Following are the main activities of the NGO in these villages:

- *Education:* The NGO adopt one primary and one secondary government school in every village. They provide training to teachers, conducts distance education courses, and conduct health check-ups for students.
- *Healthcare:* There is a health center for every village where a doctor visits for 2 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 garbage collection system for all villages. The garbage collector generates and sells manure from the garbage to make the system self-sustainable. Drinking water plants have been set in some villages, they provide door-delivery of water at 10 paise per liter (USD x per gallon).
- *Ashwini Centers:* 20 villages have computer centers. These are used to provide distance education to students at school times. 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 local language, Telugu. For every 3-5 villages, the NGO has positioned a Nodal Coordination Officer (NCO) to oversee activities in these villages. The NCO can understand English and is a degree holder in any subject. The NCO can operate the computer. Every village has a Gram Vikas Samitee (GVS) that is a committee of 18 members from the village who have volunteered to work with the NGO on the 18 different modules.

B. Needs Gathering on the Field

We visited four villages accompanied with 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 the varying demographics to get a broader perspective. The first village (Vandram) has agriculture as the main source of livelihood and paddy is the main crop. Juvvala Palam is one of the larger villages and is geographically located as the central hub for nearly 4 lakh population in nearby villages. This village has a large population base that deals with renting of transport vehicles and so the associated business of mechanics, drivers is also very common. The third village (Cherukumilli) is primarily aquaculture based and has a number of fish ponds where aqua farmers cultivate fishes. Ibhimavaram is a very wealthy village where farmers have large lands and they usually employ labourers to cultivate their farms. Except for Cherukumilli, all the other three villages had a computer center (called as Ashwini Center). The chart in Table I summarises the important inputs gathered in the field.

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 screen. All cell-phone users are number-literate and can recognize English language digits. However very few can understand the roman script for characters.

The cell-phone signal is sufficiently strong in all remote areas. Although there are lot of electricity blackouts, but these intervals are short in duration, thus charging of cell-phones is not an issue. There are two major service providers (Airtel, BSNL), however there are about 5 different service providers available.

Most officials and village committee members mentioned that people will be interested in knowing several schedule

TABLE I
SUMMARY OF INFORMATION NEEDS IN FOUR VILLAGES.

Village	Population	Families	Mobiles	Main Oper- ators	DTMF	Will pay?	Information Required	Remarks
Vandaram	2292	450	150	Airtel/ BSNL/ Idea/ Voda- fone	Depends on value of infor- mation.	Not initially.	Program schedule of Ashwini, Information categorised on Modules, Pesticides, Medicines, Aqua information, sports updates, railway enquiry.	Yes for pilot
Juvvala Palam	3800	850	600	Airtel/ Tata/ BSNL/ Voda- fone	Voice is better	same as above	Community news, agriculture info, NO to train, no to Electricity, doctor visit, Teleconferencing information announcement, panchayat meetings, ankur channel program schedule. Hub village for 4 lakh population in nearby villages.	Yes for Pilot
Cherukumilli	4047	1000	500	Airtel/ Idea	Voice	After realising the value, they may. Not initially.	information about village, Panchayat meetings, GVS meetings	
Ibhimvaram	4600		3000	Idea/ Airtel	Voice	Yes	Tractor renting, electricians, etc. panchayat meeting, national fish rates, V-agri, V-agri, v-agri	GVS very interested for pilot.

related information such as distance education class schedule, village committee meting schedule and minutes. Other information needs were based on agriculture information, community news and crop rates. For the Juvvala Palam village, people were interested in knowing about electricians, mechanics and different rental options for farming equipments. Except for Ibhimavaram, other villagers mentioned that the villagers may not pay for the service initially, but once they can see value from the information, they have the capacity to pay for the information.

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

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

utes, sports achievements, etc.

It was clear from the on-field interactions that a phone-based information portal that enables interaction through voice will be ideal from the end-user perspective. Such a system will ensure that the end-users will not need to learn any new interaction modality nor a new device. Given the significant cell-phone penetration, a cell-phone based system can be used to fulfill the information needs of these villages.

IV. 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 a parallel to a Website, but which can be accessed by dialing a phone number and information can be *listened* rather than being read or seen. Creation of a VoiceSite is made easy by the VoiGen system [27] through which anyone can call up the VoiGen system and interact with it through voice. This can enable any illiterate person to create her 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 type of users can update content in different sections. We explain the type of users and their interaction with the VoiKiosk in the next section. The kiosk operator (typically a NCO or a VCO) navigates through the VoiKiosk application

to configure it to offer various services for the village. Figure 4 shows a sample operational scenario for the VoiKiosk.
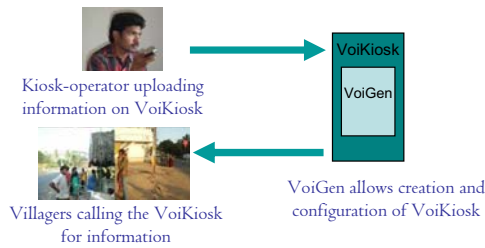

Fig. 2. VoiKiosk Usage Scenario

A VoiKiosk act as information and service portal for a village. It can be a central point of access for a community 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 directly interact with the services, thus removing the dependence on the kiosk operator.

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 turn-around time for this process is 24 hours. With VoiKiosk, the expert will be able to post his advice for the farmer on the VoiKiosk, reducing the turn-around time to 4 hours. VoiKiosk identifies farmers based on their caller IDs.
- *Health Information:* Information related to different health advisory and health camps is posted in the VoiKiosk. The schedule of the doctor visit to the health center is also posted on the VoiKiosk. The VCO can change the message if there is a change in the doctor visit timing.
- *Ashwini Center Schedule:* Information regarding new programs, 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 the ashwini centers to get this information in person. The VoiKiosk has a Ashwini Center section where a kiosk operator can post the latest news related to the distance education program.
- *Professional Services:* In this section users will be able to record their personal advertisements. In the current practice, micro-businesses such as mechanics, drivers, daily wage skilled laborers use word of mouth advertising to reach out to clients. VoiKiosk provides an opportunity to increase their client base and increase business opportunities for them. Users call the VoiKiosk and record their advertisement which other villagers can browse by calling the VoiKiosk.
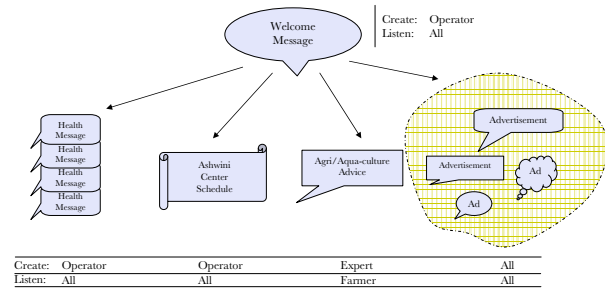

Fig. 3. Information on VoiKiosk: categories and access

As shown in Figure 3, the information in these four categories can be modified by different kind of users. All information is accessible to everyone, except for the expert advice, which is specific to a particular farmer. We discuss about 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 to modify the welcome message for the VoiKiosk system, or 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.
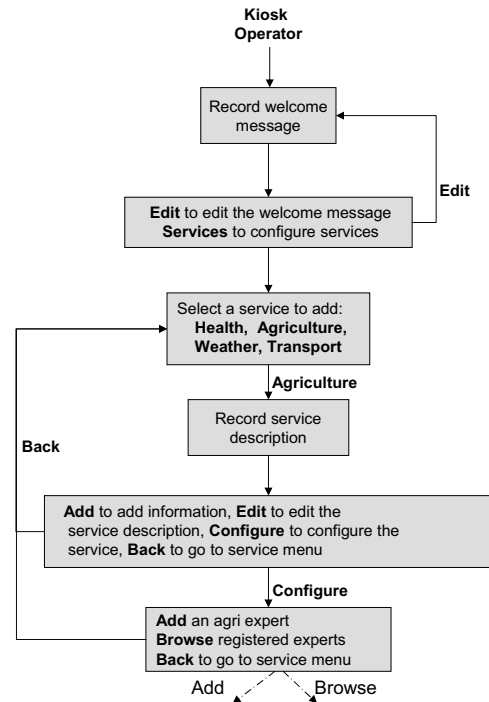

Fig. 4. VoiKiosk Usage Scenario

V. PARTICIPATORY DESIGN OF 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 the VoiKiosk system:

- *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 identifies his caller-id and provides 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 can not post comments in any other category.
- *Farmers* call in the system to listen to any message from experts. They can listen to information in other categories too.
- *Villagers* can post an advertisements, or listen to any other general information in the VoiKiosk.

A kiosk operator is usually identified for the VoiKiosk. The kiosk operator has permissions to add different categories, and also to add and delete information in any category. 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 this to the field to get feedback from the four different type of end-users. Since the Kiosk Operator has the maximum number of options available on the VoiKiosk, we started our testing with 2 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 used to record user voice and not at the time when the system would do a speech recognition on the voice. Since this fact was not known to the users, they did not know when to start speaking. Sometimes they would respond too early and sometimes they were too late. This resulted in increased frustration and so to make sure that they are speaking in the interval when the system accepts their input, they kept on repeating the same utterance, such as "*exit, exit, exit*". *We modified the VoiKiosk interface so that after every system input, there was a beep sound.* The users could then figure out that they are always supposed to wait for a beep sound before they respond. This improved the system performance significantly.

There was a system prompt that asked the following from the users: "*Do you want information on Health or Agriculture or Ashwini Center Schedule or you want to about the people in this village?*". We expected that people will respond by saying either of *Health, Agriculture, Ashwini Center* or *People*. However the users used to answer *Yes* or No. So we had to change the prompt to "*Please say Health to know about health related information, or say Agriculture to ...*". Although these descriptive prompts are too lengthy and not so natural, but this community preferred to listen to prompts that clearly tell the user what to say. This was a very good insight from these participatory design experiments. Users in village have more patience and prefer simple descriptive system prompts as compared 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.

Fig. 5.   Initial prototype testing with the farmers.

From the experts perspective, they wanted that any advice they post to the farmers should also be archived in the NGO IT infrastructure. The NGO believes that this database of specific advices can act as a knowledge resource in the future. We created a 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 as well at the time of listening. The other option was to ask the users to press a specific key to explicitly let the system know the end of utterance. But this would involves 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 less to record some of the messages from the experts. 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 secs for the Experts. They now have to press the # key to indicate the end of the utterance in case of background noise.*

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 2 minutes to update a message.*

VI. USABILITY OF VOIKIOSK

The VoiKiosk was tested with the villagers for a period of four months. We present the usage statistics of the VoiKiosk system by analysing 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 on the backdrop of the changes that were made in the system over time. This will provide more details about the effects of the usability of the system with improved 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 4000 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, especially paddy 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 field and for a specific social function such as a wedding. The village 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 about 2000 rupees (USD 50). All cellphone users are comfortable dialing numbers and talking with other people. However the use of text-message is very low. As a rough estimate, only about 10% of villagers use text-message for communication on cell-phone. This is due to the fact that the local language (Telugu) is not supported on the device and since only about 20% of people know very 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 of MS Office, spoken English, embroidery and painting classes for adults. Villagers from the Juvvala Palam village participated in the pilot.

B. Overall System Usage

The VoiKiosk system was live, 24 hours a day and all seven days of the week for four months. In these four months, the system received a total of 20499 calls from 976 villagers. We assume that a unique phone number would map to a specific villager because the trace to users is based on the caller identification in the VoiKiosk system. Table II shows the number of calls that went to the different services in the VoiKiosk. The advertisements section of the VoiKiosk was accessed maximum number of times. The third column in this paper shows the percent of the total number of calls that access this service. Since this number does not add to 100, not every call accesses a service.

Users spent a total of 477 hours on the VoiKiosk system. The average call time was 83 seconds, with a maximum of 49 minutes and minimum of zero seconds.

The number of calls have been increasing since the pilot was launched. The graph in Figure 6 hints at the increased acceptability of the VoiKiosk system over time. On an average,

TABLE II
SUMMARY OF DIFFERENT SECTIONS VISITED BY USERS.

Description	Number	Percentage
Agriculture	1640	8%
Health	2383	11.6%
Ashwini Center	1749	8.5%
Advertisements	7492	36.5%

while there used to be about 50 calls per day at the start of the pilot, the last week of the pilot has witnessed more than 300 calls every day. The 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 feedback. The caller base increased from these 30 users just by word of mouth and has reached even the neighbouring villages. We have had villagers from the neighboring villages calling and creating their advertisements on the VoiKiosk.
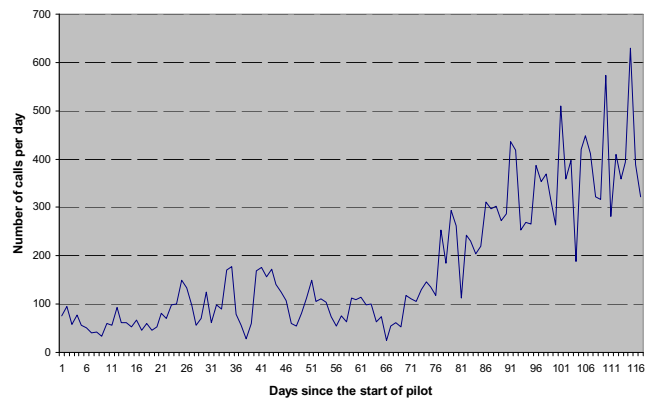

Fig. 6.   Number of calls per day, starting from the launch of pilot.

While most calls were during the afternoon and late evening times, we were surprised to see calls arriving at 2:00 am. There were a total of 99 calls received between odd hours of 11:00 pm and 5:00 am. Figure 7 shows the calling pattern during different times of the day. This is an aggregate number summed over the number of calls in the four months.
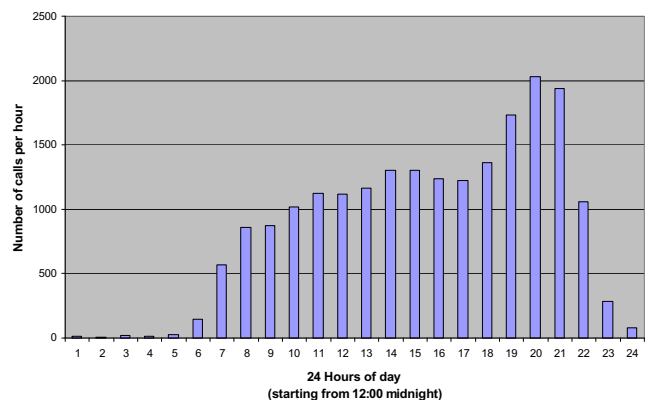

Fig. 7.   Hourly breakup of number of calls in the day.

There were a total of 2528 advertisements recorded by 463 different users. Many people recorded their advertisement multiple times over the period of four months. Although one person can record only one advertisement, people often call again either to improve their advertisement, or to record a fresh advertisement. One caller had recorded his ad 62 times. Though most callers had recorded it only once. The graph in Figure 8 shows the different callers and the number of times they have recorded their advertisements.
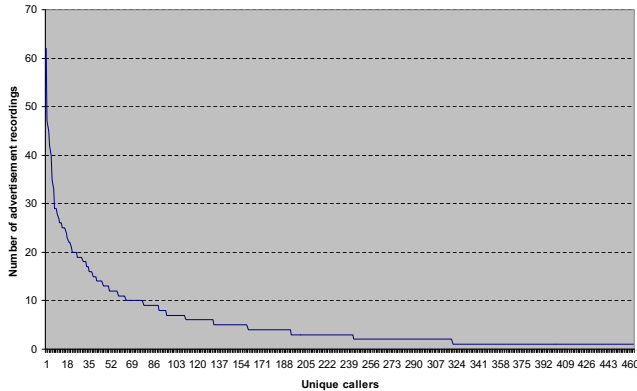

Fig. 8. Advertisement update frequency of callers.

C. Improvements with Changes in Interface

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

1) Enabled easy navigation of advertisements by providing options to jump to next advertisement through keypad input.
2) Enabled easy recording of advertisement by allowing users to record without them having to listen to any advertisement.

The initial system was live for 70 days. After the first change, the system was live for 21 days and then after the second change, it was live for 30 days. Table III shows the number of calls, average call time, number of advertisements and unique callers in the three situations.

TABLE III
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 ADVERTISEMENTS.

System State	No. of calls	Average time	Unique callers
Initial System	6239	79	335
Modification-1	4437	104	227
Modification-2	9820	75	412

It is interesting to note that over a period of these four months, the number of advertisements have been increasing. Even then, 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 advertisements before she could post her own advertisement. The reason behind this was that by listening to the advertisements, a novice user will know what to speak in her advertisement. When the number of advertisements increased beyond 20, we noticed that the users were still patiently listening to them and then would post their advertisement. 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 long list of information over phone as compared to what has been observed with the western population's experience with spoken dialog systems.

And/OR

The villagers ascertain certain value to posting an advertisement and so are ready to wait for a long time in order to get a chance to post.

When the number of advertisements increased beyond about 40, we provided option to jump to the next advertisement by pressing a key on the phone keypad. Perhaps the users were comfortable with navigating the VoiKiosk system by then, and therefore they were able to learn the keypad navigation. It should be noted at this point that during the needs-gathering phase, the users had clearly mentioned that navigation through keypad will not be easy and 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 75 seconds when we provided 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.*

VII. DISCUSSIONS

The advertisement section attracted the most attention, and was accessed the most. Initially, we had a couple of users (a mechanic and a truck owner) upload personal (classified-type) advertisements to the VoiKiosk. Inspite of 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 till he was satisfied that all the details he wanted to capture were recorded.
  - Another person created a "response advertisement" 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 note 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, and (b) Even

though they may have never heard of social networking on the Web, 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 advertisements section evolved to a message-board by 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 act as 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 the lack of alternatives, most likely both.

Of the 20499 calls received on the VoiKiosk system, only 2532 were for creating the content. Creating the content in the VoiKiosk is either by recording of an advertisement by a villager or by recording of other messages by the Kiosk Operator or the agriculture Expert. Therefore, more than 87% of the calls were for accesing the content on the VioKiosk system while only about 13% 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 have provided more details about the advertisements rather than the agriculture, health and ashwini center. This is because the other three categories were mostly information upload from one specific person (either the Kiosk Operator or the Expert), and the access was to the villagers. Therefore these services, although important, were different from the advertisements because the latter had *user generated content*. By providing the ability for all villagers to create content, VoiKiosk becomes a much more participatory platform for rural areas.

Although the statistical analysis proves the acceptance of the VoiKiosk system by the 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 in terms of the usability of the system and the value of the content. We also plan to provide more critical services such as daily crop prices to registered farmers and medication reminders to patients through the VoiKiosk system. It will also be interesting to observe the usage pattern of a different village and identify the similarities and differences and question whether they reflect the demographics of that village.

VIII. CONCLUSION

In this paper, we present a information kiosk system for use in rural areas to create and access locally relevant content. We identify the information needs in rural areas by talking to villagers and the NGO. We develop VoiKiosk – a voice-based system that can be accessed by a phone to provide a cost effective solution that is easy to use by the less-literate people in rural areas. We test 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 South India and we captured user statistics for 4 months. More than 900 users used

the system over a period of four months. Users made about 20000 calls to this VoiKiosk system. We present the usage pattern obtained by different modifications in the VoiKiosk over these four months. We provide a detailed description of how some of the services were used beyond what they were designed for. This leads to an interesting insight into the social networking applicability of the VoiKiosk system.

The increasing use of the VoiKiosk system for the 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.

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REFERENCES

[1] "World Urbanization Prospects: The 2007 Revision Population Database," http://esa.un.org/unup/.

[2] Ministry of Finance, Government of India, "Economic Survey 2001-2002," http://indiabudget.nic.in/es2001-02/chapt2002/chap106.pdf.

[3] Population Reference Bureau, "World Population Data Sheet," no. ISSN 0085-8315, Aug 2006.

[4] S. Agarwal, A. Kumar, A. A. Nanavati, and N. Rajput, "Voikiosk: Increasing reachability of kiosks in developing regions," in *Proc. Intl. Conf. on World Wide Web (WWW)*, China, April 2008.

[5] T. S. Parikh and E. D. Lazowska, "Designing an Architecture for Delivering Mobile Information Services to the Rural Developing World," in *Proc. Intl. Conf. on World Wide Web (WWW)*, May 2006.

[6] S. Seshagiri, A. Sagar, and D. Joshi, "Connecting the bottom of the pyramid: An exploratory case study of india's rural communication environment," in *Proc. Intl. Conf. on World Wide Web (WWW)*, China, April 2007.

[7] B. Kolko, E. Rose, and E. Johnson, "Communication as information-seeking: The case for mobile social software for developing regions," in *Proc. Intl. Conf. on World Wide Web (WWW)*, Canada, May 2007.

[8] D. Ramachandran, M. Kam, J. Chiu, J. Canny, and J. L. Frankel, "Social dynamics of early stage co-design in developing regions," in *Proc. CHI*, USA, April-May 2007.

[9] C. K. Prahalad, "The Fortune at the Bottom of the Pyramid: Eradicating Poverty Through Profits," in *Wharton School Publishing*, 2004.

[10] E. Brynjolfsson and L. Hitt., "Paradox lost: Firm-level evidence on the returns to information systems spending." *Management Science*, vol. 42, April 1996.

[11] "Netcraft Web Server Survey," http://news.netcraft.com/archives/web_server_survey.html.

[12] K. Matthee, G. Mweemba, A. Pais, G. V. Stam, and M. Rijken, "Bringing internet connectivity to rural zambia using a collaborative approach," in *Proc. Intl. Conf. on Information and Communication Technologies and Development (WWW)*, India, December 2007.

[13] U. Saif, A. L. Chudhary, S. Butt, N. F. Butt, and G. Murtaza, "Internet for the developing world: Offline internet access at modem-speed dialup connections," in *Proc. Intl. Conf. on Information and Communication Technologies and Development (ICTD)*, India, December 2007.

[14] G. Buchanan, S. Farrant, M. Jones, H. Thimbleby, G. Marsden, and M. Pazzani, "Improving mobile internet usability," in *Proc. Intl. Conf. on World Wide Web (WWW)*, Hong Kong, May 2001.

[15] R. Heeks, "Information Systems and Developing Countries: Failure, Success, and Local Improvisations," *The Information Society*, vol. 18, March 2002.

[16] E. R. Megwa, "Bridging the Digital Divide: Community Radio's Potential for Extending Information and Communication Technology Benefits to Poor Rural Communities in South Africa," *Howard Journal of Communications*, vol. 18, October 2007.

[17] F. Hussain and R. Tongia, "Community radio for development in south asia: A sustainability study," in *Proc. Intl. Conf. on Information and Communication Technologies and Development (WWW)*, India, December 2007.

[18] S. R. Sterling, J. O'Brien, and J. K. Bennett, "Advancement through Interactive Radio," in *Proc. Intl. Conf. on Information and Communication Technologies and Development (WWW)*, India, December 2007.

[19] T. S. Parikh, "Designing an Architecture for Delivering Mobile Information Services to the Rural Developing World," *Ph.D. Dissertation, University of Washington*, 2007.

[20] T. S. Parikh, P. Javid, S. K., K. Ghosh, and K. Toyama, "Mobile Phones and Paper Documents: Evaluating a New Approach for Capturing Microfinance Data in Rural India," in *Proc. CHI*, Canada, April 2006.

[21] Y. Schwartzman and T. S. Parikh, "Using CAM-equipped Mobile Phones for Procurement and Quality Control at a Rural Coffee Cooperative," in *MobEA V, Mobile Web in the Developing World*, Canada, May 2007.

[22] M. Plauche and M. Prabaker, "Tamil market: a spoken dialog system for rural India," in *Proc. CHI*, Canada, April 2006.

[23] J. Sherwani, N. Ali, S. Mirza, A. Fatma, Y. Memon, M. Karim, R. Tongia, and R. Rosenfeld, "Healthline: Speech-based access to health information by low-literate users," in *Proc. Intl. Conf. on Information and Communication Technologies and Development (WWW)*, India, December 2007.

[24] R. Veeraraghavan, N. Yasodhar, and K. Toyama, "Warana Unwired: Replacing PCs with Mobile Phones in a Rural Sugarcane Cooperative," in *Proc. Intl. Conf. on Information and Communication Technologies and Development (WWW)*, India, December 2007.

[25] "MobilED Initiative," http://mobiled.uiah.fi/.

[26] T. Leinonen, F. Aucamp, and E. Sari, "Audio Wiki for mobile communities: information system for the rest of Us," in *Workshop on speech in mobile and pervasive environments, Mobile HCI 06*, September 2006.

[27] A. Kumar, N. Rajput, D. Chakraborty, S. Agarwal, and A. A. Nanavati, "Voiserv: Creation and delivery of converged services through voice for emerging economies," in *WoWMoM'07 Proceedings of the 2007 International Symposium on a World of Wireless, Mobile and Multimedia Networks*, Finland, June 2007.

[28] S. Agarwal, D. Chakraborty, A. Kumar, A. A. Nanavati, and N. Rajput, "HSTP: Hyperspeech Transfer Protocol," in *ACM Hypertext 2007*, UK, September 2007.

[29] A. Kumar, N. Rajput, S. Agarwal, D. Chakraborty, and A. A. Nanavati, "Removed for blind review," in *Proceedings of the World Wide Web*, April 2008.

[30] A. Kumar, N. Rajput, D. Chakraborty, S. Agarwal, and A. Nanavati, "Removed for blind review," in *SIGCOMM Workshop on Networked Systems for Developing Regions*, Japan, Nov 2007.

[31] "Byrraju Foundation," http://www.byrrajufoundation.org.