Mapping Interactive Voice Response Call Data in Developing Regions

Aditya Vashistha, Edward Cutrell and William Thies
Microsoft Research India
{t-avash, cutrell, thies}@microsoft.com

ABSTRACT
In this position paper, we discuss the importance of adding location data to the information collected using Interactive Voice Response (IVR) systems in the developing world. We also discuss various approaches to input location data using basic phones, as well as open research questions.

Author Keywords
ICTD, HCI4D, Interactive Voice Response Systems, Maps

ACM Classification Keywords
H.5.2 User Interfaces

General Terms
Human Factors; Design

INTRODUCTION

While location data is easy to collect using high-end tablets, smartphones, and 4G Internet connections, in remote rural areas of a developing country like India, the only pervasive, accessible and robust technology interface is a basic mobile phone. There has been limited study to date on how users with limited education can report location data using a low-end phone. While SMS is available, low literacy and limited font support makes it difficult for many disadvantaged communities to leverage SMS.

For many users in the developing world, the most natural mode of interaction with mobile phones is that of voice. These communities have digit literacy and know how to answer an incoming call and make an outgoing call from ubiquitous basic mobile phones. Interactive Voice Response (IVR) systems are more usable than text and can offer an intuitive interface for providing information to and collecting data from underserved rural and urban communities. In recent years, various researchers and practitioners have used IVR systems for citizen news journalism [1], agricultural discussion forums [2], community dialogue, user-generated maps, access to health information [3], outreach to sex workers [4], rural employment exchange, and viral entertainment platforms.

In this paper, we discuss the need for mapping IVR data, and various ways to input location on basic phones.

NEED FOR MAPPING IVR CALL DATA

There are several advantages of adding location data to the calls coming into an IVR system. Let's understand each advantage with the help of a scenario.

GeoHCI Workshop at CHI 2013, April 27–28, 2013, Paris, France.

Visualizing Data on a Mapping Platform

Consider an IVR system that aids disaster relief initiatives: people can call a number to report the progress of relief effort, pressing 1 if they are satisfied with the efforts and pressing 2 if they are unsatisfied. The consolidated data visualized on a mapping platform would be pivotal to track the overall progress of the relief efforts and to identify areas where additional efforts are needed. As another example, consider an IVR system for citizen news journalism, where citizen journalists can report the location corresponding to the reported news. The reports can be visualized on a mapping platform to create an early epidemic warning or to evaluate the state of law and order in a region.

Location-Aware Playback of IVR Content

Presently, there is no mechanism to provide location-based voice data to the users of an IVR system. In the case of a nationwide citizen journalism IVR system, a citizen journalist in a village in Karnataka may be more interested in news reported by others from nearby villages. Having location data corresponding to each story will enable the IVR system to play data intelligently for the callers. It is important to prioritize playback order because either the caller or IVR service provider is paying for every second spent on listening to the content on an IVR system.

APPROACHES TO GET LOCATION DATA

In this section, we are documenting all possible methods to get the location data when a user calls an IVR system.

Automatic Inference of Location

There are limited ways to get location data without any explicit action from a basic phone user. We cannot use a smartphone application to send GPS data to the IVR server as GPS-enabled smart phones aren't used by the target demography. Precise location data can also be fetched by using cell triangulation which is done by Mobile Network Operators. However, they neither have permission nor have any incentive to share users' locations with third parties. Another approach is to use callers' mobile phone number to infer their calling region. For example, information in [5] can be used to infer the calling region of a caller in India. However, the location data obtained from this approach has coarse granularity (only up to a state level). Moreover, due to new schemes like free roaming services and mobile number portability, the information in [5] will be diluted in coming years. The last approach is to use Cell Broadcast

Service (CBS) messages which are broadcasts sent by cell towers to all phones in its range [6]. A cell tower typically broadcasts the locality name in a CBS message. Though the location mapped using this approach is quite accurate (within a range of 500 meters), a programmable phone is needed to run an application to decipher the location from received messages. Unfortunately, the target demography does not have programmable phones, and even if they did, there is not a good ecosystem for them to discover and download the application.

Manual Entry of Location

In this section, we propose some approaches to solicit location data directly from the user.

Use Postal Code

In rural India, the majority of the population still relies on postal mails for long distance communication. Hence, it is probable that they know the postal code of their area or can find it easily. In periurban and urban India, it is relatively easy to find the postal code as some shops and buildings print postal codes on their sign boards (along with their name and address). Location information collected using this approach is accurate to the operating geographical boundaries of a post office. Information can also be easily inputted using DTMF or speech input. However, remembering or finding the postal code of a location is certainly an overhead.

Use Fixed Line Area Code

Another approach is to ask callers to enter the fixed line area code to specify the location. Though this information has relatively coarse granularity as location is accurate to the city level, it can easily be inputted using DTMF or speech input. However, with increasing proliferation of mobile phones and reduction in the number of fixed line phones in developing countries, it is possible that people may not know or be able to easily find out the fixed line area code.

Use SMS

This approach relies on callers to send a text message specifying their location to the IVR number as soon as they finish calling the IVR system. Needless to say, people with limited text literacy would struggle to send an SMS.

Use Audio Recording

The most intuitive way for callers to provide location information is to just say the location name. This data can be transcribed by a moderator or by using a crowdsourcing platform. Moreover, the granularity is a function of the information provided by the caller. On the downside, a lot of resources and time is required to transcribe the speech input. The approach is not scalable if crowdsourcing is not used for transcribing the locations. Also, the information cannot be visualized immediately on a mapping platform as some time would be taken by the moderator or the crowd to transcribe the locations.

Use Numeric Keyboard on an IVR System

The number keys on a phone can be used to spell out a location over IVR, in the same way that the keys can be used to spell out a location in an SMS. Either multi-touch or predictive text entry could be appropriate for the IVR setting, or it might be possible to enhance the text entry to be more amenable to IVR. For example, each letter could be read back to the user, with an audio prompt, as soon as it is entered. However, this method nonetheless requires literacy and familiarity with text entry on phones.

Once we have location data in the form of postal code or fixed line area code or location name, we can use existing databases like [7] to find geo-spatial coordinates, and then visualize the IVR data on a mapping platform.

OPEN RESEARCH QUESTIONS

In this section, we highlight open questions which Geo-HCI researchers working in developing regions need to address.

1. Do people in rural, periurban and urban India know their postal code? How difficult is it to find the postal code of a location?
2. Do people in rural, periurban and urban India know their fixed line phone area code? How difficult is it to find the information for a location?
3. Are the answers for (1) and (2) the same for other developing and underdeveloped countries?
4. What is the granularity of a postal code? Is the granularity of postal codes the same for various regions in a country? Is the granularity of postal codes same for various countries?
5. What are the design recommendations for IVR mapping systems? Which approach offers:
   - The finest granularity of location data?
   - The minimum education/effort needed by callers?
   - Optimal processing so that data can be visualized quickly?
   - The lowest cost of processing the data?

In order to address these questions, we are doing a quantitative user study that surveys underprivileged low-literate users as well as high-income users with respect to their knowledge of postal codes, fixed line area codes, and their ability to input various information on the phone.

ACKNOWLEDGMENTS

We would like to thank Neil Patel, Trevor Knoblich, Kara Andrade and Nicholas Haralambous for their useful suggestions.

REFERENCES

1. Mudliar, P., Donner, J., and Thies, W. Emergent practices around CGNet Swara, a voice forum for citizen journalism in rural India. In *ICTD 2012*.
2. Patel, N., Chittamuru, D., Jain, A., Dave, P., and Parikh, T. S. Avaaj Otalo - A field study of an interactive voice forum for small farmers in rural India. In *CHI 2010*.

3. Sherwani, J., Ali, N., Mirza, S., Fatma, A., Memon, Y., Karim, M., Tongia, R.,and Rosenfeld, R. Healthline: Speech-based access to health information by low-literate users. In *ICTD 2007*.
4. Sambasivan, N., Weber, J., and Cutrell, E. Designing a phone broadcasting system for urban sex workers in India. In *CHI 2011*.
5. Mobile telephone numbering in India. http://en.wikipedia.org/wiki/Mobile_telephone_numbering_in_India
6. Yadav K., Naik V., Singh A., Singh P., and Chandra U., "Low Energy and Sufficiently Accurate Localization for Non-Smartphones". In *MDM 2012*.
7. Postal and Zip Codes database http://www.geopostcodes.com/