Short Paper : Challenges and Novelties while using Mobile Phones as ICT Devices for Indian Masses

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ABSTRACT

Mobile phones have emerged as truly pervasive and affordable Information and Communication Technology (ICT) platform in the last decade. Large penetration of cellular networks and availability of advanced hardware platforms have inspired multiple innovative research opportunities in mobile computing domain. However, most of the research challenges have focused on typical scenarios existing in the developed economies. In this paper, we present research challenges and novelties in mobile computing domain that take account for differences between developing in particular India and developed economies. Our research is based on commonly available mobile platforms, communication cost, differences in user behavior and acceptable societal norms, among others.

1. INTRODUCTION

With the advent of less expensive smart phones, considerable work has been done towards simple application development for extending the usability of these devices for masses, especially those in rural areas in Developing Countries [5]. Mobile phones have a potential to change the way developing economies, such as India, deliver essential social and economic services to attain sustainable growth. In this paper, we present challenges and novelties in mobile computing domain for using mobile phones as ICT devices to attain the potential in India. Figure 1 presents a simplified modular architecture for a programmable phone. We consider some of the important modules of this architecture and describe their associated challenges in coming sections.

2. PHYSICAL INTERFACE

In the physical interface module, several options exist for applications to communicate. These include Infrared Data Association (IrDA) interface, bluetooth, Universal Serial Bus (USB), cellular network (including GSM, CDMA, GPRS) and WiFi. USB is a low cost and small power consuming alternative for interfacing many external devices.

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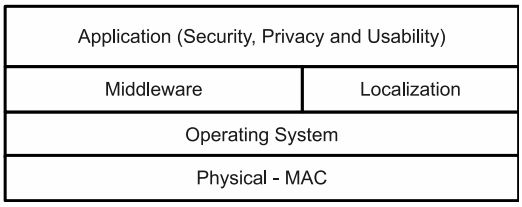

Figure 1: Simplified modular architecture of a programmable phone

However, most of the mobile phones (including many smart phones) have limited capabilities and can not function as a USB master to control any external hardware. This limitation also motivated the development of a hardware platform [4] that acts as an intermediate platform for connecting external hardware devices with mobile phones over USB. Such hardware limitations significantly increase the overall system cost for communication over USB.

Interactive Voice Recognition (IVR) systems have already been in use for more than a decade and are currently pervasive in several environments, including call centers and telephone banking. Motivated by the IVR systems, we propose the audio port on the mobile phone for communication with the external hardware device. Similar to IVR systems, one can think of producing a physical signal for an external hardware device based on a key press performed remotely. Specific key press produce different frequency signals called Dual Tone Modulation Frequency (DTMF). An application on mobile phone can decode DTMF signals to control an attached hardware device. This may not even require any software development at the receiving end if the already existing features, such as auto-answer capabilities[1] can be put into use at the receiver side. Nano Ganesh,[2] a commercially available device with similar capabilities, was our motivation for proposing this kind of solution. In Nano Ganesh, based on a pre-defined numeric key press, the device controls the switching of an electric water pump remotely over a cellular network.

3. MIDDLEWARE

Large variation in the architecture and software platforms of mobile phones makes it very difficult to develop applications that can be widely deployed across different platforms. Java 2 Micro Edition (J2ME) is a platform that is available almost on all the mobile platforms, barring iPhone. Due to

[1]auto-answering of incoming call after a preset duration
[2]http://www.nanoganesh.com/

OS	Manufacturer	Language Supported	Price Range
Android	Google, HTC, Samsung	J2SE, J2ME	$\geq$ USD 150
iPhone	Apple	Objective C	$\geq$ USD 450
Windows Mobile	HTC, Sony, HP, Toshiba, Videocon	C#, VC++, J2ME	$\geq$ USD 150
Blackberry	RIM	J2ME	$\geq$ USD 240
Symbian	Nokia, Motorola, Sony	Symbian C++, J2ME, Python	$\geq$ USD 40
Maemo	Nokia	C, Plans to support Java	$\geq$ USD 200

Table 1: Programmable mobile phones' system specifications and their cost in India

their high cost, use of iPhone is anyway limited in India. By its very nature, Java provides device heterogeneity with support for cross-compilation. Most of the mobile phones already come equipped with JVM, required for running Java programs. For phones that do not have a JVM (e.g. Windows Mobile), third party JVMs such as IBM J9 can be installed.

Table 1 describes each of these platform and the programming languages supported by them. We have identified some of basic JSRs like JSR 118 (Mobile Information Device Profile 2.0),JSR 139(Connected and Limited Device Configuration 1.1), JSR 75 (File Connection and Personal Information Management) and JSR 120(Cell Broadcast Messages) which will enable us to overcome device heterogeneity and help in deploying our application on a wide range of devices.

4. LOCALIZATION

Traditionally, GPS, WiFi, and GSM technologies are used for localizing users. Google Maps Mobile for mobile phones[3] primarily uses GPS and WiFi for localization. However, the GPS and WiFi technology can be used only on the high end phones with respective capabilities. With most of the low end phones, lacking the GPS and WiFi capabilities, GSM based localization is a good alternative as it only requires an active cellphone connection. Further, GSM based localization is more economical and energy efficient compared to using GPS and WiFi [1].

We propose a GSM-based solution, which does not use the ID of the tower to which a phone is connected. Instead, our approach uses Cell Broadcast Service (CBS) messages, that typically encode the name of neighborhood/landmark in which the tower is installed and the service provider-specific advertisement. Service providers use CBS as a value added service to provide location to users. The messages are periodically broadcasted to all the cellphone users in the neighborhood. CBS uses a different frequency space than the space reserved for SMS, call setup, call and data. This provides an advantage that even when the mobile device is connected to one specific cell tower, it can still receive CBS messages from multiple cell towers which are all in the range. This allow us to use triangulation techniques over CBS messages to increase accuracy of CBS-based Localization.

5. SECURITY, PRIVACY AND USABILITY

Security and privacy attitudes, awareness, and concerns in India (collectivist society) are very different from the developed nations, e.g. the US (individualistic society) [3]. The expectations of security and privacy is comparatively lower from technologies (mobile applications) that are being used in India. This would possibly mean that a system with resonably low level security and privacy settings may suffice the needs of users in India.

[3]http://www.google.com/mobile/maps/

Authentication in India also happens through SMS, for example, when a customer is trying to create an account for online banking, upon request, he/she receives a SMS with credentials. The customer uses the credential to complete the process of creating the account for online banking. This brings a new challenge, specific to Indian context, to make sure that the third parties (vendors who send the SMS) will not be able to sniff the information and use it for future crime; apply appropriate encryption so that the data can be deciphered only at the customer's mobile phone.

The culture and context of usage of mobile phones in countries like India throws up some interesting and tough "usability" problems to study. Majority of the users in developing nations cannot read, write, speak English and therefore keypads on mobile phones have to be developed with local/regional languages [2]. Use of local language might turn out to be one of the primary requirement for designing phones in India.

6. CONCLUSIONS

In this paper, we divided the system of a mobile phone into different modules. Such a division allows us to consider each module independently from the perspective of associated challenges and novelties. For example, at physical module we find that using audio port is more economical than bluetooth and USB is not technically feasible. Given the heterogeneity at the hardware and OS, use of Java provides portability of code. Communication using SMS and localization using CBS is less expensive and energy efficient. From, security and privacy point of view, the requirements are less demanding as compared to those in developed countries.

7. REFERENCES

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