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**Position Paper on
"Cross-cultural Usability Issues of Bilingual
(Hindi & English) Mobile Phones"**

By

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ABSTRACT

Variety of information services like Short Message Service (SMS), e-mail, news, market reports, educational applications and other reading materials are now available on mobile phones. The size of mobile phone and its display is shrinking day-by-day, whereas the volume of information content and services are growing. More importantly, mobile phones introduced in the Indian market have now become bilingual; they support various services in English and Hindi languages. Mobile manufacturers have consciously or unconsciously resorted to English oriented approaches, and as a result of this, they have diluted the culture specific rules and the original form of Hindi language. Therefore, to restore the original characteristics of Hindi in mobile phones, it has become inevitable to study the cross-cultural usability issues between Hindi and English. This study involves consideration of various aspects like keypad design, mapping of Devanāgarī alphabets, text entry techniques, rendering of fonts, paralinguistic features, legibility, layout and pagination, navigation through text, grammatical structure of textual content, translation of user interface and reading comprehension. We have studied the application of Hindi in four bilingual (Hindi and English) mobile phones manufactured by different companies like Nokia / Reliance 3105 CDMA, LG RD5130, Motorola C118 and Samsung / Reliance C200. Ten linguistic usability heuristics have been identified and applied for revealing several linguistic usability problems and cross-cultural issues in mobile phones. Our study provides sufficient reasons for standardization of keypad layout, Devanāgarī alphabetical rendering, and Hindi translation of English technical terms used in mobile phones. This position paper provides the basis for enhancing the usability of Hindi application in mobile phones.

KEYWORDS

Bilingual Mobile Phone, Cross-cultural Usability, Linguistic Usability Heuristics, Hindi and English, Devanāgarī Script, Keypad Design, Fonts Rendering, Reading Comprehension

1. INTRODUCTION

1.1 About Hindi Language

Hindi is the national language of India and it is spoken by at least 402 million Indians as per the Census of India conducted in 2001. Ideally, entire 1 billion population of India is desired to communicate in this language. Furthermore, there are several countries like USA, UK, Mauritius, South Africa, Yemen, Uganda, Singapore, Nepal, New Zealand, Germany, Pakistan, etc. which have significant Hindi speaking population. The number of people communicating in Hindi is enormous and hence it is necessary to study the uniqueness and culture specific requirements of Hindi, especially when it is introduced in mobile phones. Hindi originates from *Sanskrit*¹ and it is written in *Devanāgarī*² script. It has been influenced and enriched by many other languages such as Dravidian, Turkish, Farsi, Arabic, Portuguese and English. Unlike other languages enlisted here, English has continued to impact Hindi through modern technologies and media even today.

1.2 Impact of English

One could consider any two languages, in case of bilingual mobile phones. However, English has been specifically mentioned considering that it is the most popular international language available on most mobile phones. Word-processing and document publishing tools, printing technology and other media of communication are highly influenced by English. This is mainly due to natural tendency of western scientists to design technologies suiting the requirements of English as their first priority. English style of typing, text rendering, formatting, layout design, and presentation techniques are getting forced on other world languages including Hindi, due to worldwide proliferation of modern technologies and media. Technology developers have consciously or unconsciously resorted to English oriented approaches, and consequentially, they have diluted the culture specific requirements and the original form of Hindi. Therefore the usability of Hindi application in mobile phones has become questionable.

It is inevitable to study the cross-cultural usability issues between Hindi and English for restoring the original characteristics of Hindi in mobile phones. It is an accepted fact that Hindi and English will require to co-exist together. **We conduct this cross-cultural study with the objective of making them co-exist without imposing on each other, and without sacrificing their originalities, and in the most usable fashion. It is necessary to resolve the cross-cultural usability issues in bilingual mobile phones first, which will eventually pave the right path for multi-lingual mobile applications.**

1.3 Our Approach

Many cross-cultural issues between Hindi and English languages are applicable to wide range of media. However, we have focused on the application of Hindi in mobile phones only. These are highly constrained communication devices in

¹ The ancient and sacred language of the Hindus in India.

² The script in which Sanskrit and several dialects of India are written.

terms of small size of handset, limited display resolution and storage capacity. The cross-cultural usability issues tend to become more severe due to such limitation of resources. We have studied the application of Hindi in four bilingual (Hindi and English) mobile handsets manufactured by different companies.

These are namely-

- **Nokia / Reliance³ 3105 CDMA**
- **LG RD5130**
- **Motorola C118**
- **Samsung / Reliance C200**

We have focused on script-based application of Hindi and English in Mobile phones. Our evaluation of Hindi and English is from the perspective of 'reading comprehension' because it is the ultimate objective of any written communication through mobile phones. It allows us to consider the entire set of linguistic aspects like text entry, script, word formation, grammatical structure, legibility, readability and navigation through text. Proposed cross-cultural usability study of mobile phones is intended to help in design and development of more usable mobile phones for Hindi users. This has paramount importance; as the total number of mobile users in India is likely hit 100 million by 2007, as per the report published on W2FORUM.

1.4 Definition of Cross-cultural Issues

Due to unavailability of a comprehensive and specific definition of 'Cross-cultural Issues in HCI', it is defined as under-

“Cross-cultural issues are basically the unique requirements of different civilizations or societies or communities of people asking for change in the design of product or technology or system or service to make it more usable and acceptable.

The cross-cultural issues can be studied in terms of racial characteristics, life-style, traditional practices, geographical and political contexts, social rules and values, histories, religions, languages and mental models of people.”

In the light of this definition, we have tried to identify the requirements of Hindi mobile users and evaluated the usability of bilingual mobile phones introduced in the Indian market.

1.5 'Linguistic Usability Heuristics' for Bilingual Mobile Phones

Following 'linguistic usability heuristics' are identified and applied during our evaluation of bilingual mobile phones. The heuristics will be useful for qualitative

³ Reliance Infocomm Ltd. is one of the major mobile service providers in India. Nokia and Samsung have exclusively provided the mobile handsets to Reliance.

evaluation of any other languages introduced in mobile phones and also serve as design guidelines.

1. **Represent the language in its original form**
2. **Maintain the original form and structure of script**
3. **Uniform representation of the language**
4. **Avoid influence of English or any other language**
5. **Maximum 4 alphabets / characters per key**
6. **Least typing effort**
7. **One-to-one correspondence between keys and alphabets typed**
8. **Avoid uncontrolled mixture and trade-offs between languages**
9. **100% legibility of text**
10. **Readability / comprehensibility of text**

The cross-cultural issues between Hindi and English documented in this paper are discovered through application of aforementioned 'linguistic usability heuristics'. We have referred them by their serial numbers in our deliberations henceforth. We also observed many subjects while performing certain tasks with the help of bilingual mobile phones.

1.5 Basic Differences Between English and *Devanāgarī* Scripts

As per the heuristic nos. 1, 2, and 4, we have identified the basic differences between Devanāgarī and English scripts. These heuristics are applicable for most of issues documented in the paper.

Devanāgarī script has 14 vowels and 36 consonants. Each consonant has 14 variations through integration of 14 vowels. This produces about 504 different alphabetical characters (Glyphs). It has 10 numerals similar to English. Whereas, English has only 26 alphabets. The alphabetical complexity of *Devanāgarī* is quite obvious.

Devanāgarī script does not have separate Capital and Small alphabets as in English. Also, *Devanāgarī* has adopted many punctuation marks and paralinguistic features such as italic, bold, underlined lettering styles from English.

Also, Hindi or Sanskrit originated languages do not have the tradition of making acronyms and short forms as practiced in English. In English SMS, one tends to drop vowels for the speed of typing e.g. 'shld' for 'should' or 'tbl' for 'table'. **In *Devanāgarī* script the vowels are integral part of consonants and therefore they can not be separated or dropped for making shortforms in SMS.**

English alphabets do not alter their basic shapes. On the contrary, a *Devanāgarī* alphabet alters itself drastically with addition of *Mātrā*⁴ and conjuncts (merging of two or more consonants).

⁴ The vowel mark in *Devanāgarī* script.

English script does not encode the conjuncts but they are pronounced in speech. But *Devanāgarī* script encodes the conjuncts exactly the way one would pronounce it.

English alphabets are designed with basic geometric shapes like vertical, horizontal, diagonal and circular lines. It also uses a lot of symmetric shapes. The designs of alphabetical shapes are grid based and highly optimized. They became more simplified through the evolution of block printing and now the digital media. In a given font, the shape of an English alphabet is frozen and is not subjected to any dynamic change. These qualities make English script more suitable for low-resolution bitmap rendering in mobile phones.

On the contrary, *Devanāgarī* alphabets have asymmetric, free flowing and highly intricate shapes. Most importantly, the shape of an alphabet is subjected to lot of modification and dynamic changes due to addition of *Mātrā* and conjuncts. These qualities make *Devanāgarī* script very complex and challenging for low-resolution bitmap rendering in mobile phones.

Such script level differences between *Devanāgarī* and English are primarily due to influence of oral traditions in India and dominance of print culture in Western countries. So far we have discussed general observations of *Devanāgarī* and English scripts.

2. DEVANĀGARĪ KEYPAD USABILITY

***Devanāgarī* keypad layouts of various mobile phones are compared in the light of heuristic no. 3. This heuristic is also applied to study many other aspects of mobile phones in this paper.**

2.1 Bilingual Alphanumeric Keypad Layout

The keypad layout of all mobile phones is exclusively designed for English script. The main problem is that designers have to forcefully fit *Devanāgarī* script on this keypad. This approach has disturbed the original structure of *Devanāgarī* script. It is worthwhile to design exclusive keypads for bilingual mobile phones. Special mobile phones with *Devanāgarī* and English support can be a lucrative proposition if you consider the large number of users in India. But it is important to do proper justice to a language and its users.

As seen in Figure 1, English alphanumeric keypad mapping is standardized for all mobile phones. English numbers and alphabets are printed in the same manner on all keypads. On the contrary, as seen in Figure 1, *Devanāgarī* alphanumeric keypad mapping is non-standardized and follows different approaches. The printing of alphabets on keys also varies in terms of the sets of alphabets and their locations on keypad.



LG RD5130

Nokia 3105

Samsung/Reliance C200

Figure 1. English and *Devanāgarī* keypad of mobile phones

Let us observe and compare the keypads of bilingual mobile phones shown in Figure 1.

2.1.2 Location and Printing of *Devanāgarī* Keys

Heuristic nos. 2, 3, and 7 are applied to reveal the usability problems in mapping and printing of Devanāgarī Keys.

Traditionally, *Devanāgarī* alphabets are grouped in smaller sets for ease of memory recall. These groups are represented and mapped in different fashions on all keypads. Figure 2 shows a group of *Devanāgarī* alphabets त थ द ध न, which is mapped on different keys and printed in different styles.



Figure 2. Different approaches to *Devanāgarī* keys

The printing of alphabets on a key is meant to expose the alphabets mapped on it. It is expected to assist users while typing. **As the alphabets mapped on keys are too many, and the key size being very small, the mobile manufacturers have not printed all *Devanāgarī* alphabets on keys.**

The keypad of LG RD5130 handset displays only the first alphabet from each group, whereas the keypad of Nokia 3105 handset displays the first and last alphabets from each group on every key. The keypad of Samsung C200 shows first two alphabets of the group on each key.

The keypad design of LG RD5130 handset assumes that you would know the remaining alphabet starting from the one that is printed on every key. The keypad design of Nokia 3105 handset assumes that you would know all alphabets between the first and last alphabets that are printed on keys. The keypad design of Samsung C200 assumes that you would exactly select the desired group of alphabets.

LG RD5130 and Samsung C200 handsets display the remaining alphabets of the selected group on screen after pressing the key. But for selecting the key, user has to rely on prior knowledge. Otherwise, user will have to press all keys one-by-one to identify the correct group of alphabets.

Also *Devanāgarī* numbers are not printed and supported on any of the mobile handsets. One has to rely on English numbers only.

On the contrary, same mobile phones have all English numbers and alphabets properly printed on their keypads. You are not expected to depend on memory or prior knowledge.

In fact, *Devanāgarī* script has greater number of alphabets than English and hence expecting the users to remember them is quite unfair. Ideally, all alphabets mapped on a key must be printed on that key.

Some mobile phones have dropped out the alphabets like अः, क्ष and ज्ञ considering that they are less frequently used. By the same logic they should have dropped ड, ञ as well but these alphabets are supported. From the pure linguistic perspective it is an unpardonable mistake to drop even one alphabet.

2.1.3 Treatment to *Devanāgarī* Mātrās

Devanāgarī Mātrās are grouped, located and treated differently on all mobile phones. The choice of keys for Mātrās is also different. For example, on LG RD5130 handset Mātrās are mapped on key number 9, on Nokia 3105 handset they are mapped on key number 1,2 and 3; on Samsung handset they are mapped on 8,9, and 0 keys.

LG RD5130 and Samsung C200 handsets have provided exclusive *Mātrās*. Whereas, Nokia 3105 handset treats them as vowels fusing with consonants. Basically all approaches are grossly different.

It is extremely challenging to distribute 14 vowels and 36 consonants of *Devanāgarī* along with numbers and punctuation marks on just 12 keys. This turns out to be a very tricky problem, as the keypad of mobile phone does not provide the luxury of multiple key combinations using Caps Lock or Shift buttons as in computer keyboard.

2.1.4 Treatment to *Devanāgarī* Conjuncts

LG RD5130 provides exclusive half alphabets (ष र ऋ) for formation of conjuncts. This makes it more complex as LG handset has tried to map half alphabets on keys. As a result, they have missed out some half alphabets. Nokia 3105 and Samsung C200 use *halant*⁵ to form conjunction between two consonants.

Application of *halant* is as shown in brackets (प + ण् + त = प्त).

Use of *Halant* is the authentic way to form conjuncts.

2.1.5 Conflicting Keypad Mappings

So far we have established that the keypad mapping of *Devanāgarī* alphabets and treatment to *Mātrās and* conjuncts is very different in all handsets. As a result, if you exchange Hindi SMS between the mobile phones manufactured by different companies, it gets displayed with some undesirable characters. It is no more readable. You can smoothly exchange Hindi SMS between similar mobile phones only.

There is no accepted standard for mapping *Devanāgarī* script on mobile keypads. An optimal and usable solution to this problem is still to be evolved. The designers and mobile manufacturers need to give up English oriented thinking and concentrate on the requirements of *Devanāgarī* script.

2.2 Comparative Study of Typing Effort

In addition to the heuristics applied so far, we used heuristic no. 6 and 9 for the comparative study of typing efforts and legibility of text in various mobile phones.

As too many alphabets are mapped on every key, one has to keep pressing it several times to arrive at the desired alphabet. Such higher frequency of keystrokes can reduce the life of keypad. For example, Nokia 3105 mobile handset has minimum 6 and maximum 9 *Devanāgarī* alphabets assigned to each

⁵ *Halant* is a sign used to indicate the point of conjunction between two consonants.

key. Despite such overloading, *Devanāgarī* numbers are still not supported. If you add *Devanāgarī* numbers, it will be about 7 to 11 characters per key.

It is very strenuous to type even one word using *Devanāgarī* script. For example, we typed a *Marathi*⁶ word महाराष्ट्र in *Devanāgarī* as well as in English (*Maharashtra*) for comparing the typing efforts on various mobile phones. Table 1 shows the typing results.

Table 1. Typing Efforts					
Nokia 3105					
<i>Devanāgarī</i>	म	हा	रा	ष्ट्र	Total number of key-strokes
Key-strokes	5	10	3	18	36
LG RD 5130					
Key-strokes	5	9	3	38	55
SAMSUNG					
Key-strokes	2	4	4	8	18
English spelling of <i>Maharashtra</i> typed using all mobile phones					
Key-strokes	20				20

LG RD 5130

After pressing a key, this handset displays the particular group of alphabets on its screen. One has to keep pressing the key to arrive at the desired alphabet. It makes you press the keys too many times as it provides exclusive half alphabets for conjuncts. For typing ष्ट्र we required 38 keystrokes. Though the final output was erroneous as shown in Figure 3. What was typed by this mobile phone can be read out as 'Maharash~~tt~~a'. It does not provide half 'r' for conjunction. This handset supports the feature of predictive typing and hence simplifies the typing effort if the word is available in its dictionary.

Nokia 3105

In this handset, typing in *Devanāgarī* follows a pretty simple approach. One has to just go on pressing a key to arrive at the desired alphabet. *Halant* can be used for conjuncts. The *Devanāgarī* font supported by this handset is too tiny and not legible enough.

SAMSUNG C200

This handset provides the most optimized technique for typing in *Devanāgarī* and it is more efficient than English. But it is based on some new rules and makes it quite technical for the users to understand. As shown in Figure 1., this handset converts each alphabet to a number. For example, while typing ग, one would require to press key number 3 but if you see this key, it represents the group of alphabets starting from ङ. This approach makes it confusing and less intuitive,

⁶ The regional language used in *Maharashtra* state of India. It uses *Devanāgarī* script similar to Hindi.

as one has to rely on the displayed reference of alphabets to find out the associated numbers. It is not desired by the users to remember the numbers associated with alphabets. It is quite unnatural to reduce an alphabet to a number.

This approach is an impediment in the human tendency to build *micro-cognitive maps*⁷, which are developed through practice of using remote controls and mobile phones. They are helpful in intuitively locating and pressing of buttons / keys on a device.



Figure 3. The word 'Maharashtra' typed using different mobile phones

Correct depiction of the conjunct ष्ट्र (*shtra*) appearing towards the end of *Maharashtra* may be compared with the screenshots shown in Figure 3. The problems are easily noticeable. Unlike other mobile phones, Samsung C200 mobile phone renders this conjunct quite accurately.

2.3 Attention Span and Visual Recognition

Another problem that we spotted has to do with the attention span of users and visual recognition of *Devanāgarī* alphabets. In mobile phones, while typing the text, if you keep pressing a key without pausing even for one moment, it changes to the next alphabet. This is a standard technique. But if you pause for a moment, it accepts the alphabet typed by you as final input and the text cursor moves ahead.

This behavior forces one to repeatedly press a key to arrive at the desired alphabet. In case of *Devanāgarī*, it amounts to pressing a key for 6 to 9 times. For English, it is only 3 to 4 times.

While frantically pressing a key again and again, one ends up skipping the desired alphabet. One fails to quickly recognize it due to its small size and ambiguous shape. It is also quite tiring to keep gazing at the location where alphabets are speedily changing. Naturally you cannot recognize them quickly, and then you have start typing all over again.

We must appreciate and accept that the attention span of mobile users is very short unlike the computer users. We observed during our experiments that the subjects are unable to track the number of keystrokes when they

⁷ Mental images encoded with relationships and relative positions to help in navigation through spatial layout of keys or buttons

were more than 4 times. This observation provides vital justification for coining the heuristic no. 5.

3. LANGUAGE SETTINGS OF MOBILE PHONE

When you set Hindi as the language in your Mobile phone, it is reasonable to expect the entire user interface to be presented in Hindi. In this setting, you come across two types of problems, which are namely- 1. Language dropouts and 2. Use of non-translated English terms.

We applied heuristic no. 8 to identify the uncontrolled mixture between languages.

3.1 Language Dropouts

You always find some features continuing to display the English user interface. The contact list and telephone numbers continue to appear in English only. Presently, most mobile phones are capable of switching over to hard coded Hindi user interface. Apparently, the mobile application developers have been forgetting to translate some parts of user interface while converting to Hindi.

The automatic transliteration of names and numbers from English to Hindi is a demanding task but a necessary one. But it is yet to be attended by the developers. The keypads of mobile phones supporting Hindi language continue to carry English numbers. Also while dialing a phone number, it gets entered in English.

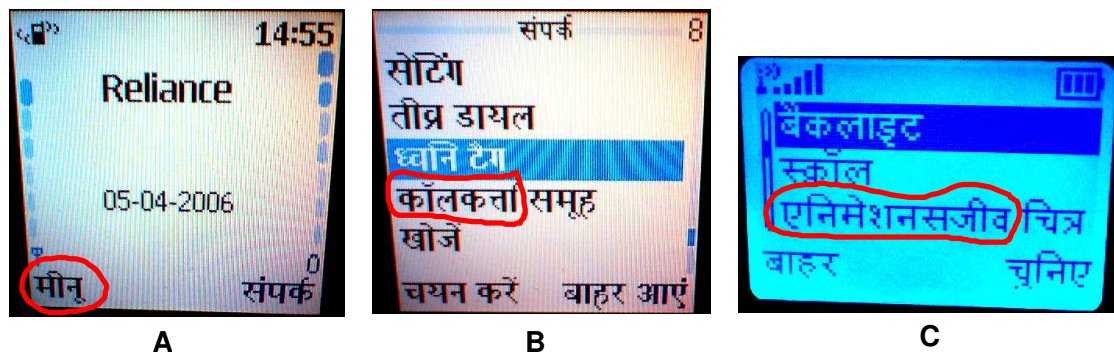


Figure 4. Use of English Terms in Hindi

It is safe to assume that users who switch their mobile phones to Hindi language may not understand English. There is a strong reason to believe so, as most vegetable sellers, labor workers, villagers, and people who come from the lower strata of society in India do not know English. From the point of view of 'quality', the mobile companies are not fulfilling the commitment of supporting Hindi language, though they claim it. The language dropouts can cause reading problems to many mobile users. They may not understand English user interface or face difficulty in entering and reading contact details in English.

3.2 Add-hoc Use of English Terms in Hindi

Figure 4/A and B are the screenshots from Nokia 3105 handset and Figure 4/C is a screenshot of Motorola C118 handset. As shown in Figure 4, translation of many English technical terms into Hindi is a common problem. Many times it amounts to coining new Hindi terms.

Figure 4/A at bottom of its left corner shows that the term 'menu' is written in *Devanāgarī* without translation.

Figure 4/B shows a new term for Caller Group (*Callerkartā Samuhā*, as pronounced in Hindi), which is half English (Caller) and half Hindi (*Kartā Samuhā*). The same figure also shows 'Setting' written in Hindi and 'Speed Dial' written in half Hindi (*Tivra*) and half English (Dial). The translation of 'speed' as '*Drutagati*' is more appropriate. So there are translation errors as well.

Figure 4/B also shows another term wherein 'Tag' is written in Hindi. This figure also shows two functions at the bottom of the screen, written as '*chayan kare*' (select) and '*bāhar āye*' (exit). Figure 1/C shows more optimized translation of these functionalities. But their positions have been swapped.

Figure 4/C shows a weird term, which is a mix of half English (Animation) and half Hindi (*Sajeev*). It does not make any sense.

Also one finds the plural of 'call' written in Hindi as '*callen*'. We found about 42 English terms (about 30-40% of total instructions in user interface) written in *Devanāgarī* script in Nokia 3105 handset. These are enlisted in Table 2. Nobody has attempted to translate them in proper Hindi language. One can infer that 30-40% of English instructions written in *Devanāgarī* are incomprehensible to those who do not understand English.

It is worth constituting a national committee of linguists and mobile technology developers to standardize Hindi terms for use in mobile phones. This is very much feasible as the English vocabulary used in common mobile applications is very limited. In our study of Nokia 3105 handset, we found out around 42 English terms written in *Devanāgarī*, these are enlisted in Table 2. Also the English technical terms acceptable in Hindi may be formally decided and declared. The mobile companies should be persuaded to comply with such standard unless they introduce new terms for new features and applications. The standard of Hindi terms for mobile phones may be updated and enriched periodically.

This will maintain the purity of Hindi language used in mobile applications. It will also enrich Hindi language by addition of new vocabulary and terms. It will improve the usability of mobile phones for Hindi users. It will also promote Hindi and boost the propagation of mobile phones in Hindi speaking world.

Table 2 English terms written in Hindi in Nokia 3105			
मीनू	Menu	प्रोफाइल	Profile
नंबर	Number	मीटिंग	Meeting
सेटिंग	Setting	पेजर	Pager
डायल	Dial	फोन	Phone
टैग	Tag	नेटवर्क	Network
कॉलकर्ता	Caller	कोड	Code
स्कॉल	Scroll	पुनर्डायल	Redial
वी आई पी	VIP	डीटीएमएफ	DTMF
बिजनेस	Busyness	बैनर	Banner
इनबॉक्स	In Box	गैलरी	Gallery
आइटम	Item	फोल्डर	Folder
इ-मेल	e-mail	ग्राफिक्स	Graphics
स्क्रीन	Screen	मेल बॉक्स	Mailbox
टेम्प्लेट	Template	रिकॉर्डर	Recorder
स्माइलि	Smiley	कॉललॉग	Call Log
छूटी कॉले	Missed Calls	अलार्म घडी	Alarm Watch
कॉलों की सूची	Call List	कैलेंडर	Calendar
अॅनिमेशन	Animation	कैलक्युलेटर	Calculator
अनलॉक	Unlock	स्टॉपवाच	Stopwatch
कॉलींग कार्ड	Calling Card	कैलोरी गणक	Calorie Counter
डाटा कॉल	Data Call	डाटा दर	Data Rate

3.3 Bitmap Fonts and Rendering of *Devanāgarī* Alphabets

Heuristic nos. 2 and 9 are used to study the rendering of Devanāgarī Alphabets in mobile phones.

The mobile phones chosen for study support 128 x 128 pixels display resolution. Drawing of *Devanāgarī* alphabets using limited number of pixels is extremely challenging. Such fonts are generally created using 12 to 18 pixels height, which includes the ascending and descending margins required for *Mātrās*.

The mobile companies have created bitmap fonts for *Devanāgarī* but they require major improvements. Most common problems found in these bitmap fonts are-

- Uneven spacing of alphabets
- Distorted shapes of alphabets
- Uneven height and width of alphabets
- Intersecting or overlapping alphabets
- Insufficient leading between two lines
- Ambiguous and non-recognizable shapes
- Dislocated *Mātrās* and disjointed conjuncts

Devanāgarī numbers shown in Nokia 3105 (Refer Figure 5.) are of varied heights and some of them are unrecognizable. Some examples of correct alphabets and their erroneous shapes in mobile phones are shown below.

ज्ञ ज य घ ७ ५

ज्ञ is looking like ज. य looks like टा. ७ looks like 0. ५ looks like ८.

With such poor legibility, how will business transactions succeed through mobile phones? If numbers are not displayed accurately then the financial decisions can result in blunders.

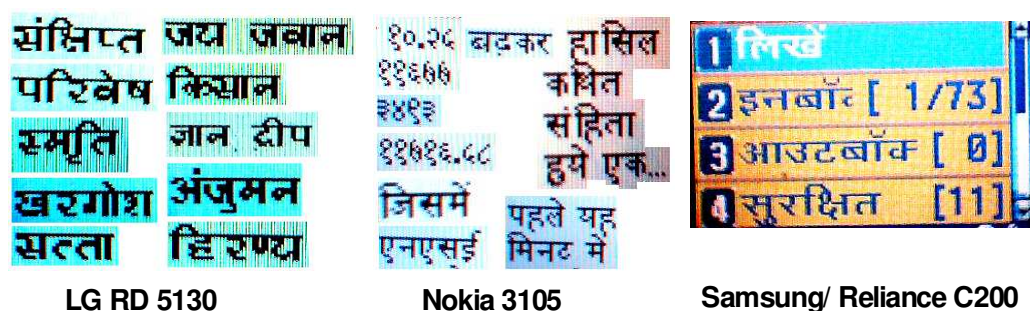


Figure 5. Rendering of *Devanāgarī* Alphabets in Mobile Phones

3.3.1 Legibility Versus Space Limitations

Nokia 3105 allows you to view 7 lines of *Devanāgarī* text on its screen but it is very eye straining to read. Samsung C200 uses auto-scrolling text as part of menus to maintain legibility of text and to manage the long length of text.

Introducing paralinguistic features like italic, bold, normal, underlined fonts and other font styles for *Devanāgarī* script in mobile phones is a much harder task. But they will be necessary if large amount of information is to be presented in readable manner.

3.3.2 Matching Height of English and *Devanāgarī* Fonts

Matching height of English and *Devanāgarī* fonts is also a major problem. In the example shown here “C-DAC सी-डैक”, English lettering is using 14-point height whereas *Devanāgarī* lettering of same word is using 18-point height. Though visually they both appear matching in height. If you keep both in 14-point size then *Devanāgarī* lettering appears much smaller e.g., “C-DAC सी-डैक”. This problem is faced where one has to use English and *Devanāgarī* together. **You have to choose between ‘point accuracy’ and ‘optical judgment’ while deciding the matching height for both the scripts.**

4. READING COMPREHENSION

Heuristic no. 10 has been used to identify the problems dealing with readability and comprehensibility of text in mobile phones.

Nowadays, mobile service providers are providing variety of services in which they offer daily news reports, stock market updates, horoscopes, banking services, SMS, e-mail, etc. These are mainly text based. One is expected to browse through and read large amount text. Let us look at the issues of reading comprehension in mobile phones.

4.1 Sentence Level Readability Problems

The size of mobile display screen is shrinking day-by-day, whereas the volume of information content is growing. The display screens provide very tiny space for showing this information content. This space is very limited both in its height and width. It is possible to accommodate around 3 to 4 words in a line, which is also a matter of concern. In a typical newspaper column one can fit 6 to 7 words and a book can accommodate 8 to 10 words in a line. It is obvious that one cant read even a simple sentence properly without having to scroll it.

4.1.1 Compound Sentences

One has to keep scrolling down to view the remaining part of a compound sentence. The user has to scroll up again to see the earlier part of sentence and to recollect the context.

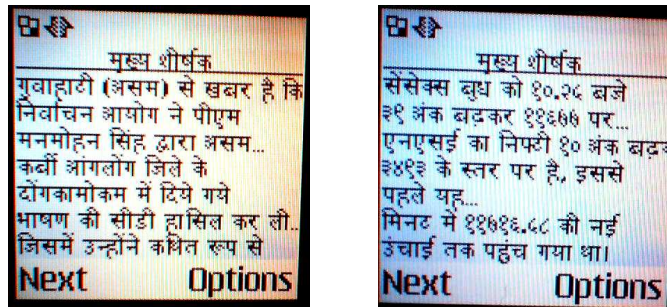


Figure 6. News reports offered by Reliance World mobile service

We found that readers tend to forget the portion of text that goes out of display area. They have to take conscious efforts to memorize it. In a compound sentence, the initial parts of a sentence describe its context. Many mobile users fail to comprehend the overall meaning of sentence due to forgetting the context. This problem is applicable to both Hindi and English languages.

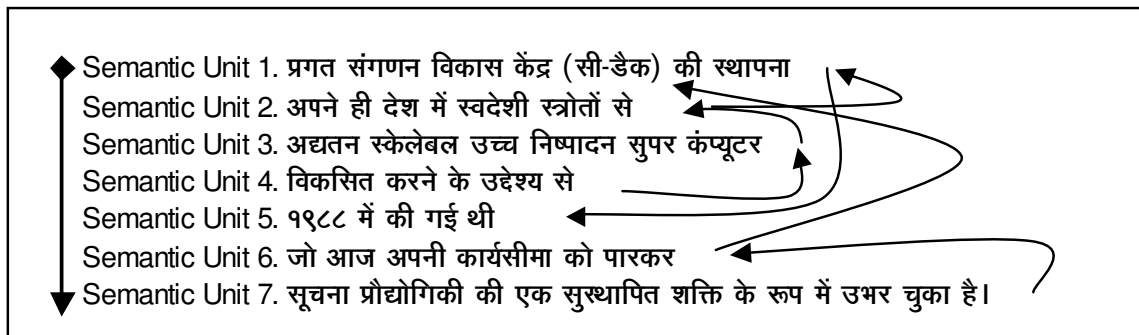


Figure 7. Non-linearity in reading comprehension

We never read in completely linear fashion. We always need to glance at earlier sentences or the parts of a sentence for better comprehension. In mobile phones one is not able to do this very effectively. As shown in Figure 7, every sentence is made up of many semantic units⁸. In a compound sentence there are greater number of semantic units and they are connected to each other. Though reading is a linear activity, the need of comprehension forces you to scan the sentence back and forth.

4.2 Grammatical Sentence Structure

Grammatical construction of sentences in English and Hindi is also quite different. Figure 8 shows how the semantic units of a sentence written in English and Hindi are placed in different order. These structural differences are due to the respective grammatical rules of languages. Let us look at some examples.

Hindi uses *postpositions* (मुंबई शेयर बाजार में) and English uses *prepositions* (In Mumbai stock market).

In Hindi, *verb* follows the *noun* (निवेशकों द्वारा भारी बिकवाली) and in English, the *noun* follows the *verb* (selling by the investors).

Similarly, the *subject* and *predicate* in Hindi and English can appear in different order.

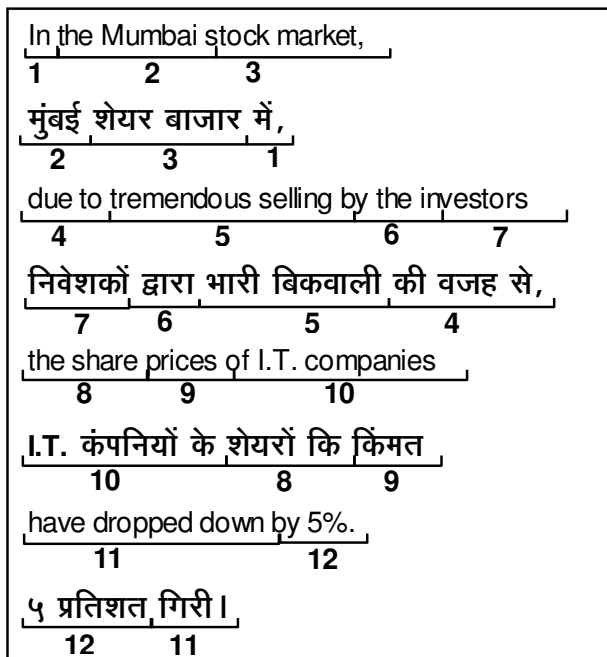


Figure 8. Grammatical construction in English and Hindi sentences

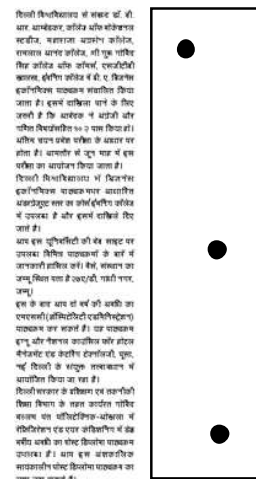


Figure 9. The advantage of spatial cues in printed text

⁸ The portion of a sentence contributing significant meaning

These grammatical aspects are worth considering while studying the reading comprehension issues of Hindi and English text presented through mobile phones. While scrolling down the Hindi text, the *noun* is likely to go out of display area first. On the contrary, in an English sentence, the *verb* is likely to go out of sight first. These differences can have impact on the comprehension of text. This type of study should be helpful in identifying the dropouts of comprehension. The observations stated here should be helpful to those who create textual content for mobile phones.

4.3 Disorientation While Reading Large Amount of Text

After reading a column of information from a printed sheet, most readers are able to recollect the location of particular information. As shown in Figure 9, they could place dots on a rectangular representation of the column to suggest the location of specific information. On a printed sheet, one gets the advantage of remembering the text layout and certain spatial cues. The paralinguistic features also make it simpler to remember the textual content. It helps readers in constructing the *mental schemata*⁹ of text.

In case of mobile phones, major part of text remains out of sight while reading long news reports. In our experiments, we found that readers get disoriented while reading and navigating through the text. It is because they are unable to build the *mental schemata* of overall page layout.

We found that readers are unable to get spatial cues while reading scrollable text in mobile phones. They are unable to recognize their position in the overall text. And hence they forget some part of the content after reading. Also, you see them scrolling up and down, back and forth as they do not remember the location of particular information.

Margins, paragraphs, pagination, indexing and navigation are the other unattended aspects of text in mobile phones. Sooner or later, they will have to be addressed, as mobile phones are becoming the most effective medium for communication, business, learning and entertainment.

Mobile phones supported with other world languages are bound to face similar usability, compatibility and readability problems as discussed in this paper. The real challenge is to make these languages coexist in mobile phones, without diluting their original form.

5. BENEFITS

Next 100 million potential users of mobile phones in India are bound to operate mobile phones in Hindi or other Indian languages. Various text based mobile applications dealing with trade, agriculture, education, tourism, health and entertainment will require to be designed. This is quite possible in near future due to rapid enhancements in storage capacity, display technology, and connectivity

⁹ Mental image of the layout or structure of content.

of mobile phones, and more importantly the dropping prices of handsets and services.

The market of next 100 million mobile users can be created only through usable and effective mobile applications. Any informative application or service is largely dependent on text-based communication and user interface design. Concentrating on linguistic usability in mobile phones can make this happen. Therefore, various design issues and linguistic usability problems discussed in this position paper need to be addressed on priority.

Stronger reasons can be found in the way Republic of China has dealt with the high technology standards. Chinese government is setting its own technical standards through China Electronics Standardization Institute (CESI). It is mandatory for the foreign companies to comply with their standard to do business in China.

6. CONCLUSION

Our heuristic study has revealed several linguistic usability problems in mobile phones and the cross-cultural issues between Hindi and English. It provides sufficient reasons for standardization of keypad layout, *Devanāgarī* alphabetical rendering and Hindi translation of English technical terms used in mobile phones. The findings of this paper can provide basis for enhancing the usability of Hindi application in mobile phones. The general findings are summarized as under.

- It is necessary to study the culture specific requirements of languages for their application in mobile phones. Keypad design, mapping of alphabets, text entry technique, rendering of fonts, paralinguistic features, legibility, layout and pagination, navigation through text, grammatical structure of textual content, translation of user interface and reading comprehension are the most fundamental aspects for identification of cross-cultural issues involved in bilingual mobile phones.
- The keypad layout should be designed as per the original structure of language without bending the rules or sacrificing the details. The existing linguistic habits and preferences of users may be considered rather than introducing new rules and techniques. The keypad design should not expect from users the prerequisite knowledge or expertise of a language. The keypad should be usable for even unskilled users. Various human factors involved in text entry process may be considered while designing the keypad layout and the input mechanism. The keypad layout for *Devanāgarī* script should be standardized.
- Hindi translation of most common English terms may be standardized for mobile phones. Also the English technical terms acceptable in Hindi may be formally decided and declared. The mobile companies should be persuaded

to comply with such standards unless they introduce new terms for new features and applications. The standard of Hindi terms for mobile phones may be updated and enriched periodically.

- Rendering of *Devanāgarī* alphabetical shapes needs to be standardized for quick visual recognition and to avoid the distortions of alphabetical shapes in mobile phones. Similarly, the paralinguistic features for *Devanāgarī* bitmap fonts need to be designed for mobile phones.
- Content creators and mobile application developers need to understand the grammatical differences between Hindi and English to design the content and display techniques. It can help in making the textual content more readable and understandable.
- Such linguistic usability evaluation is imperative for all world languages and their applications in mobile phones. It can help in retaining the original form of language and making it more usable.

7. FUTURE SCOPE

It is necessary to study the use of Hindi SMS or regional language SMS by semi-skilled workers, those coming from rural background, housewives, middle aged and old people in India. The usability and readability problems faced by them need to be identified for enhancement of the keypad user interface and the actual language components in mobile phones. It is necessary to explore the possibility of creating short forms for Hindi words similar to English short forms used in SMS communication. A special study needs to be carried out in India, for identifying the culture specific interpretations of iconic interfaces in mobile phones. It will also be interesting to study the usability issues dealing with the scripts of Urdu, Arabic, Japanese, Chinese, European languages, etc.

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