Indic scripts based online form filling - A usability exploration

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Abstract

Emerging Markets are very different from other developed markets in the diversity of the user needs, motivations and the business environment dynamics. The average citizen in the emerging markets, especially from the lower socio-economic segment, is not computer-savvy, and often only semi-literate. He or she is fluent in the local, and knows little or no English. Also, because of the poor penetration of computers in these markets, handwriting still plays a central role in all spheres of life – from transactions and record keeping in business, to personal communication. India provides an ideal testing ground for this research because of its multilingual milieu (18 official languages supported by 10 official scripts, hundreds of unofficial languages and many minor scripts).

In this paper we report the findings of a usability test, which was carried out with handwriting recognition based interface developed in Tamil to find out the preferences and user experience of the target population with a novel input device. The accuracy of handwriting recognizers is seen as a factor in determining the acceptability of these interfaces, but the task context also has a heavy influence in the acceptability (Frankish, Hull & Morgan 1994). In this study we investigated subjective ratings based on the user- computer interaction and did in-depth interviews and found out the potential of these interfaces is also very much dependent on task context, interface controls and the editing tools it provides. Also we got an insight into the cross-cultural difference that is very typical in the Asian testing grounds.

1 Keywords

Indic scripts, Pen based interfaces, stylus, usability study, handwriting, cultural difference

2 Introduction

Given the widespread use of handwriting for various tasks in the emerging markets and the complexity of existing computer interfaces and keyboard layouts, well-designed pen-based interfaces that use handwriting in the local languages for data entry can help automate many of these existing processes in these markets, as well as allow citizens access to new IT products and services. Text entry in Indic language has been quite a daunting task because of non-availability of Indic keyboards and also due to the steep learning curve associated with these keyboards. Input devices and interfaces require a schema, which can be learned very easily and also retained to acquire a decent speed in further usages. These keyboards were never able to appeal to a novice user, who essentially "hunts and pecks" for touch typing, these interfaces and keyboards don't make much sense as there is no cognitive reference to hunt a key increasing the reaction time as well as usage time to frustratingly high levels (Joshi & Rathod, 2002). Considering how much of our daily lives involve reading and writing, it seems likely that interacting with computers will involve a significant amount of text entry for a long time to come. This suggests that a major impediment to the widespread use of computers is the problem of finding a convenient way to enter text (Goldberg & Richardson, 1993).

Our primary goal was to test the usability of handwritten recognition input and we tried to see the preferences of masses towards Indic script handwriting recognition. We here proposed a handwriting-based interface that also accommodates a Tamil keyboard providing the users the best of both worlds i.e. handwriting recognizing and keyboarding. Our hypothesis was based on the fact that a pen (stylus) based input system with handwriting recognition facilitates a novice mode and has a huge satisfaction factor where in the user can imitate his handwriting on an interactive device and get 'good' results based on handwriting recognition algorithms. A pen (or stylus) is very attractive because it works very well over the entire range of sizes of computers unlike a physical keyboard. However, it seems not very convenient for text entry because of errors related to recognition. Another appealing aspect of combined display and input surfaces is that they approach the form factor of paper and are graspable user interfaces Because of this, these systems can be manipulated very much like a piece of paper (Balakrishnan, et.al., 1999). A better-designed interface with good recognition percentage that mimics paper editing and manipulations, which has the same affordances as the paper might as well succeed in these emerging economies

2.1 Form filling in India

Form filling for various governments, financial and educational domains is largely done in local Indic languages only, with 90% of forms in government being filled in local languages[1]. Hindi is by far the most prominent language used for form filling (especially in the Central Government, and the northern Indian states). For other state government forms, the local language of the state is usually used for form filling. Moreover, most of the forms in banking institutes are in multiple languages[2]. In financial services almost all the forms are bilingual. Interestingly, though urban form filling is largely in English and semi urban forms are bilingual, most of the forms used in rural areas are in local languages (90%). Users essentially either fill these forms on their own or through agents. Again based on their intellects and experience they either do online form filling (on the computers, PDAs, mobile phones) or a paper form filling.

3 Parameters of a pen text entry system

As per (Goldberg & Goodisman, 1991) these are few major parameters that characterize handwriting recognition systems:

- *Boxed unboxed entry:* The key issue is who decides how to group strokes into letters?
- *Recognition feedback:* Does the system provide feedback after each letter, immediately displaying the result of the recognition? Or does the user signal the system after entering a unit of text, at which point the system recognizes that whole block of text at once.
- *Writer independence/ dependence:* Is the system writer independent, or does it require each user to first train the system to learn his handwriting?

Our system uses boxed input for Tamil. This simplifies the recognition process (into recognition of isolated symbols). Our initial observation indicated that since Tamil uses the "halanth" or vowel-muting diacritic to break up consonant conjuncts into discrete symbols, native writers were quite comfortable writing the script in boxes.

For the feedback we tried both models. With the first model, we found that the users had a tendency to go and correct recognition results as soon as they occurred. This was found to disrupt the flow of writing for some writers. Hence the second model was adopted for the version used in the usability study. Our handwriting recognition system is a combination of both dependent and independent models; we call it writer-adapted system. Writer-specific training can be used to improve accuracy of the otherwise basic writer-independent recognition.

4 The experimental set up

The aim of the study was to understand the overall usefulness and usability of online form filling and editing compared to paper based form filling and editing. We also investigated users familiarity with standard computer controls such as radio buttons, checkboxes etc. Moreover, as the current implementation was less accurate than the

[1] Personal communication with the Director of Central Govt. Printing Press, Bangalore
[2] Personal communication with the Manager of Printing & Stationary department of Canara Bank, a major national bank

expected accuracy of 95% recognition, we also tried to understand user acceptance for an ideal online form-filling environment using Wizard-of-Oz testing.

We ran the usability study on an Indic script pen-based interface implemented on a tablet PC with 16 participants. The recognizer was implemented on a HP tablet PC using Microsoft windows for pen software environment as shown in Figure 1. The recognizer was set to operate in a boxed entry mode, which required the users to write discrete characters in separate boxes. The users were asked to write around 140 Tamil characters in the first round and then the system was adapted to each one of the participants. After this stage participants were asked to perform the tasks in random order so as to negate order effect within the subjects.

Figure 1: the tablet PC setup and interface

4.1 Subjects

The data reported here were taken from a total of 16 subjects, which were segregated in 2 groups, namely – technology savvy and technology novice. The selection was made based on their familiarity with online input methods (i.e. interaction with computers, cell phones, PDAs etc). All of these subjects had absolutely no prior experience of pen computing, handwriting recognition interfaces and evaluation was based on subjective ratings and in depth interviews.

5 Usability measures

Objective measures of usability derived from quantitative performance measurements (i.e. words-per-minute, task completion time, efficiency of observed interaction sequence) traditionally generate more reliable data than subjective measures. However, subjective evaluation constitutes an equally reliable measure of usability as objective evaluation and there is some indication that a positive correlation may exist between these two types of evaluation (Herman, 1996).

We used a 7-point Likert scale for our post evaluation satisfaction ratings. The first choice on the positive side is 5 in this scale. And we considered 5 as the minimum requirement for a “usable” product. We set ourselves a usability goal of 80% of the maximum rating of 7, which was 5.6, to check the usability and satisfaction level of our handwriting recognizer.

5.1 Measurable criterions

We set four usability criterions, which we wanted to test with the group of users to check their comfort level with the handwriting recognizers. They were

- Learnablity
- Efficiency
- Control
- Satisfaction

All questions that were asked during the post evaluation session were segregated in these four verticals of usability.

5.2 Analysis

5.2.1 Overall ratings for the Usability Criterions

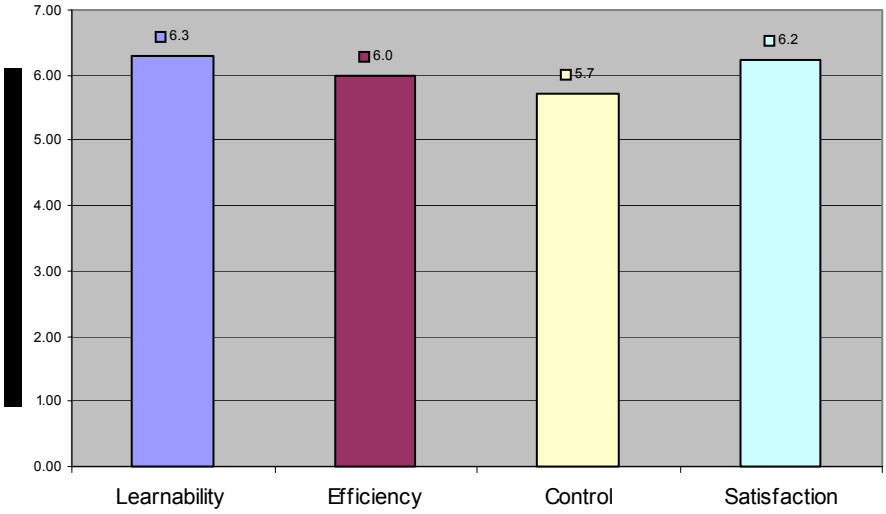

Figure 2: Usability Criterions

All these usability criterions scored above the 5.6 that is the 80% mark, which we set initially as a goal for our interface and recognizer. This suggested that the majority of the users accepted the interface.

5.2.2 Comparison: Tech Novice Vs Tech Savvy participants

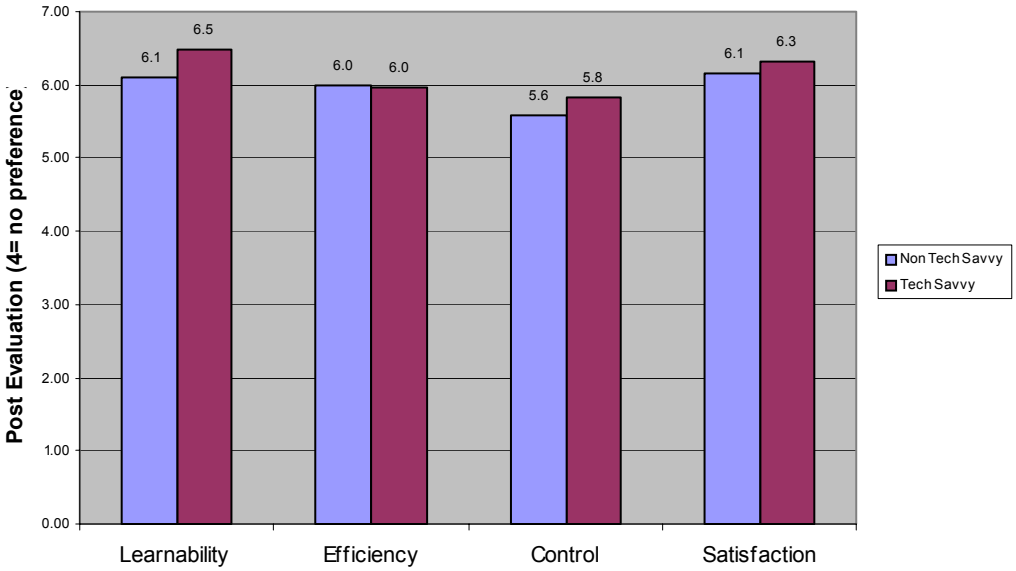

Figure 3: Tech Novice Vs Tech savvy bar graph

It is important to evaluate how the subjects might differ in their contributions to the averages seen in the overall satisfaction rating. Here, we evaluate whether tech savvy quotient impacts how they rate the various questions. We observed here that non-tech savvy users with no online experience give a bit low ratings on all the usability dimensions. Thus, we may reasonably speculate that the greater the online experience, the more favourably disposed the users are towards online form filling. This is reasonable, given that the more experience one has on a task, the more familiar, and thus easier the task becomes

5.2.3 Learnability

We observe from this graph that for almost 88 % of the users (14 out of 16), the application facilitates learning and also the retention is quite high.

5.2.4 Efficiency

On the efficiency criterion, the users rated the product a bit low. 5 of 16 users that are 31% of the users rated it below the Grade B 5.6 scale. This was because of the low recognition percentage, which was frustrating the users.

5.2.5 Control

In comparison with all the dimensions, control got the lowest ratings because of some factors namely; recognition problem, pen tip alignment problem and the unfamiliarity of controls and widgets. Especially, the novice users with less or minimal computer/ online experience faced these problems.

5.2.6 Satisfaction

All the users gave relatively higher average ratings to satisfaction, compared to other usability criterions with only two users falling below the grade B level of 5.5. The most satisfying factor was the editing option, which can never be achieved while paper form filling. Also, the online writing experience and the ‘cool’ factor associated with the device was a big plus which satisfied the subjects.

6 Usability findings

6.1.1 Moving and Controlling pen-on-tablet movements on the screen is a new skill but can be learned very quickly

Users' first impressions of using a non-inking pen on the screen are that it feels a bit startling and different. But as the words start getting recognized and within a few minutes of practice, the apprehension seems to go. Some of the users described it as "a magic slate" where you easily write, delete and edit all your writings. Furthermore, subjects showed significant savings in the speed of pointing, tracing and writing after only first set of Tamil writings which lasted for almost 6-8 minutes, and by the end of full test session all subjects felt competent in writing on the screen.

6.1.2 Users' notion: they are wrong computer is right

All the users when interviewed felt that there is some problem with their handwriting and they need to adapt to the always-correct computer. They all tried to change their handwriting during most of the editing options, so that the recognition accuracy can be improved. Also when interviewed they all felt that there was some problem with their handwriting, which cropped up recognition problems.

6.1.3 Users don't change their writing styles while normal text entry

During the whole testing there was no evidence of continuous adaptation of writing styles to bring them more into line with specific features or requirements of the recognizer. If this had occurred, we would expect to see a gradual

and continuous improvement in character recognition. There was no sign of this over the period of the test session, although user adaptation may still occur over a longer period of use.

6.1.4 *Only rewrite and re-entry changes the speed and writing style*

There was a progressive reduction in writing speed with successive attempts at re-entry of misrecognised characters. This seems to support the notion of user's model of the recognition process as being more likely to succeed if characters are written more carefully and slowly.

This is likely to be effective only in cases where the original recognition attempt failed because characters were poorly formed, and these defects are remedied in a careful rewrite. If recognition failed because the letterforms were idiosyncratic in form or in dynamic characteristics, this type of rewrite will be less successful.

6.1.5 Boxed Vs Unboxed entry

Almost all the users (13 of 16), had a feeling that Boxed entry for the recognizer is better than a normal flowing text. This notion came out based on several factors:

- Editing is easier in boxes as selective alphabets can be selected from the boxes and can be edited easily using several editing options available.
- Writing in boxes is easier because boxes give the users more space to write individual alphabets

6.1.6 Conjunct (Jodiakshar) Recognition

Conjuncts (Jodiakshar) is very typical to Indic languages where two or more characters join together to form a single glyph. Majority of the users had a tendency to write Jodiakshars together cognitively in a single box. Even when the recognition went haywire they were not able to separate the two alphabets, as the user's mental model was that a half conjunct couldn't be written separately on its own in a disjoined box.

6.1.7 Soft keypad

Keyboard tapping was quite easy for novice users as the alphabets were arranged as in Varnmala (the standard order in which people study these alphabets), but for some expert Tamil typist (2 of 16) it was a bit surprising initially to see a different layout, but they also were quite comfortable with the new design and layout of the keyboard as they all knew Tamil varnmala.

6.1.8 Handwriting Vs Soft keyboard

Even though handwriting did not give very good recognition for many users, handwriting still emerged as the preferential mode to input data. Although being more error prone and at times difficult to enter particular idiosyncratic alphabets, it was preferred mode to enter the data. This finding indicates that users' perception of efficiency cannot be directly gauged from simple speed and accuracy measures, but its real value may be in reduced cognitive efforts and appropriateness of modality.

6.1.9 Data Entry in the data fields only

Our system required the users to tap in the data fields provided next to data labels and then write in boxes, which were provided at the bottom of the interface. Almost all the subjects when interviewed wanted to fill in the details in the text fields provided next to the labels. Some of the novice users even after repeated instructions; tried writing in the data field only. However, users learnt this limitation and adjusted over the time period.

7 Conclusions

We would like to conclude with the fact that most of our subjects did find the idea of writing on the screen with a pen and getting their handwriting recognized very attractive. Another factor that attracted them most was the editing

options, which the pen interface offers, and makes it probably, better than a paper form. The only thing that hindered the acceptability was the unreliable recognition. Foretelling from this study, future prospects of pen computing and Indic form filling using these interfaces look quite promising, if and only if the recognizer performance is matched somewhat with user's expectations.

8 Future directions and discussions

8.1 First time usability

Novice experience is principal for the success of new text input methods i.e. form filling applications. A mobile product, once specialized tools for professionals are increasingly targeted for the consumer market and from there it follows that "first time usability" is important. In other words, it may be a moot point to establish the expert, or "potential", text entry rate for an input technique, if prolonged practice is required to achieve it. Consumers may be "turned off" by their initial experience and frustration.

8.2 Cultural differences

In this usability study the results of subjective evaluation ratings tended towards the positive side; despite very clear indications of poor performance for a set of users, which we called as "Appeasers". This anomaly may be attributed to cultural effects; in particular, some of the participants in the study were less vocal, exceedingly polite and disinclined to express negative comments in front of observers. This contrasted markedly with subjects in the West. Specifically, it is considered culturally unacceptable in the Far East to criticize too openly or directly, as this may cause designers hurt or loss of face (Craig, 1993). We will be researching this Asian cultural conflict, with the belief that culture is an evident variable in the technology acceptance process and influences the attitude towards the usability testing and ratings of software products. In particular, to account for cultural affects the need to modify these 'western' usability evaluation methods for application in the East.

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