10.20378/irb-56098

Multimodal Approaches for Text Entry in Indian Language on Mobile Devices

Sanjay Ghosh
Indian Institute of Technology, Bombay,
Powai, Mumbai, India
sanjayghosh@iitb.ac.in

Abstract. Text input process in Indic scripts is complex due to the large set of complex characters and more number of user actions required to enter a syllable. Research objective is to identify and evaluate the effective ways of text input in Indic scripts on mobile devices through usage of multimodal interactions. Scope of this research includes identifying various problems faced by the users in entering Indic language text on touchscreen mobile devices, theoretically analysing few of these problems, and designing solutions for some of those through appropriate use of multimodal interactions. The overarching objective of this proposed research work is to contribute towards making the text entry in Indic script on mobile devices easy and faster. This doctoral thesis is under the supervision of Prof. Anirudha Joshi and is a part of the on-going research on Indian language text entry at IIT Bombay, India.

1 Introduction to the Research Topic

In India, with around 75% average literacy and very less English language writing competency, a better solution for text entry in several Indic languages on touch screen phones is the need of hour. This has become a crucial area of HCI research. Typing of Indic scripts or for that matter any Alphasyllabary script involves composing of a syllable by entering consonant and vowel modifiers. Additionally there are a large set of complex characters such as conjuncts, diacritic marks, etc. Thus, text input process in these scripts requires more number of user actions. Now, in a typical multimodal interaction, individual modalities play their well-coordinated roles, making them appropriate and natural for different types of tasks. Therefore, it needs to be investigated whether it will be more effective if these different actions be performed using different modalities combination. In this on-going study the following research questions were under exploration –

RQ1: Does the simultaneous use of more than one input interaction modalities improve the effectiveness of text entry in Indic script on a mobile device?

RQ2: During text entry in Indic script on a mobile device, what are the effective roles of different input modalities?

- Prior literature [1], [2] mentions several issues with typing on Indic language keyboards such as, complexity of the Indic script, longer character search time, lower accuracy, involving higher cognitive load and most importantly, very slow rate of input. Work by Joshi et al. [3], and Lauren et al. [4] suggested different approaches related to the soft keyboard layouts to improve text entry in Indic script. In terms of the problem space, our exploration fairly aligns to the aforementioned researches. Classical works by Zhai et al. [5] and MacKenzie [6] have provided theoretical modelling of few text entry methods on touch screen keyboards for English script. Now, one of the challenges in applying these modelling techniques for Indic language scripts lie in the way Indic scripts input varies from English script input. In the scope of the current research we would also investigate methods to model the text entry for Indic scripts, similar to the classical works [5], [6] on touch screen keyboards for English script.

2 Methodology and Hypothesis

As this research problem involves dual aspects, i.e. exploring and identifying the problem space (inductive) as well as defining the solution space and evaluating solutions (deductive), it calls for employing multi method studies or Mixed Method. The work till date involved only the inductive approach wherein we performed field study with 50 users from the target user group to identify and categorize various issues as well as to observe their typical usage pattern while entering Indic language text on mobile. Additionally, in the inductive exploratory phase, we performed few controlled experiments with 18 participants to understand their usage patterns while performing few tasks using multimodal interactions. At this juncture, from our field study observations we formulated the following operational hypothesis for this research.

- H1: Simultaneous use of multimodal input mechanism improves the rate of text entry in Indic language.
- H2: Effective use of multiple input mechanisms for text entry may be realized when each of the modalities perform different task, such as being used for composition of different parts of a syllable

Going forward we plan to theoretically model the process of Indic language text entry on mobile device. This modelling exercise would suggest which are the steps involved in Indic language text entry that can potentially be

improved using multimodal interaction. For few of those scenarios that theoretically indicate potential improvement, we'll design prototype solutions. Following that in the deductive approach, we plan to conduct controlled experiments with the target users through the use of those prototypes.

3 Research Progress

We started our exploration by defining the preferred user group for our study. This involved people who could write in any preferred Indian language better than they could do so in English along with moderate to high exposure of mobile phones. We then performed an open ended field study with 50 participants from the preferred user group with an objective to identify and categorize the key issues that users face in using Indian language keyboard [7]. Four totally different kinds of virtual mobile keyboards were used as stimuli in these sessions. An exhaustive list of 46 issues and points observed during the study as well as those reported in prior research were categorized into 4 categories; those due to the complexity of the script, keyboard interface, user's cognitive performance and social aspects.

On a parallel track we performed few controlled experiments wherein the users were asked to perform few tasks such as navigation and text editing by making simultaneous use of multiple interaction modalities. We evaluated their level of performance, accuracy and user experience [8] as well as analysed few of their usage patterns such as patterns of errors, modality switching and modality preferences [9]. We analysed the steps required to input various types of characters namely, consonants, matras (vowel marks), conjuncts, diacritic marks for four popular Indic language keyboards.

Our current activity involves theoretical modelling and analysing maximum typing performance on various popular Indian language soft keyboards on mobile. Challenge lies in extending and applying the theory of movement time based on the Fitts' Law and reaction time based on the Hick-Hyman's Law reported for English keyboard onto Indic language text entry methods.

4 Future work and expected contributions

Currently our research is in the stage of refining our preliminary hypothesis through theoretical modelling and exploration of few prototype solutions. Prior to making effort in directly creating various multimodal text entry prototypes, we are theoretically evaluating potential solutions. We would investigate on performance of multimodal input keyboards by first designing

few multimodal methods of text input on hypothetical keyboards, theoretically analysing the performance on those finally experimentally evaluating the same.

We believe that our research can offer the following contributions in terms of new knowledge on: 1) methods to improve effectiveness of text input; 2) solving few issues encountered during Indic language text entry; 3) theoretical modelling of text entry method for Indic script; 4) interplay of multimodal input interactions for text input.

5 Open Questions to be discussed

Here we mention few open questions and discussion points for which we would like to seek some suggestions from the community of experts.

- How to extend the theoretical modelling of text entry in Indic language?
- How much is the validity of the preliminary hypothesis mentioned earlier?
- How much is the practical viability of text entry using multimodal?
- Comment on the scope of this research.

References

[1] Joshi, A., Ganu, A., Chand, A., Parmar, V., and Mathur, G. Keylekh: a keyboard for text entry in indic scripts. In Proceedings of CHI extended abstracts on Human factors in computing systems, ACM, 2004, pp.928-942.

[2] Samanta, D., Sarcar, S., and Ghosh, S. An Approach to Design Virtual Keyboards for Text Composition in Indian Languages. International Journal of Human-Computer Interaction, 29(8), pp. 516-540.

[3] Joshi, A., Dalvi, G., Joshi, M., Rashinkar, P., and Sarangdhar, A. Design and evaluation of Devanagari virtual keyboards for touch screen mobile phones. In Proceedings of 13th International Conference on Human Computer Interaction with Mobile and Services, ACM, 2011, pp. 323-332.

[4] Hinkle, L., Brouillette, A., Jayakar, S., Gathings, L., and Kalita, J. Design and Evaluation of Soft Keyboards for Brahmic Scripts. Transactions on Asian Language Information Processing, 12(2), ACM, 2013.

[5] Zhai, S., Hunter, M., and Smith, B. A. The metropolis keyboard-an exploration of quantitative techniques for virtual keyboard design. In Proceedings of the 13th annual ACM symposium on User interface software and technology, ACM, 2000, pp. 119-128.

[6] MacKenzie, I. S. A note on the information-theoretic basis for Fitts' law. Journal of motor behavior, 21(3), 1989, pp. 323-330.

[7] Ghosh, S., and Joshi, A. Text Entry in Indian Languages on Mobile: User Perspectives. In Proceedings of the India HCI 2014 Conference on Human Computer Interaction ACM, 2014, pp. 55.

[8] Ghosh, S., Joshi, A., and Tripathi, S. Empirical evaluation of multimodal input interactions. Human Interface and Management of Information, Springer Berlin Heidelberg, 2013, pp. 37-47.

[9] Ghosh, S., and Joshi, A. Exploration of Usage Patterns for Multimodal Input Interactions. In Proceedings of the India HCI 2014 Conference on Human Computer Interaction ACM, 2014, pp. 64.