PREFACE

Computers have become an essential part of our daily life. Due to its widespread use, it is expected that everyone—sighted or visually impaired—should be able to interact with computers. Usage of a computer requires visual presentation of information for the input—hand-eye coordination to operate computer mouse and keyboard—as well as the output—to see the information displayed on a computer screen. Hence, visually impaired users are unable to interact with computers. Braille and other conventional methods have limitations while entering data in the computer. The proposed dissertation is focused on solving this problem.

The human hand is potentially an attractive input means to express additional information in comparison to the keyboard, joysticks. The recent advancement in gesture recognition algorithms and low-cost hardware development has made the use of gesture as an indispensable choice of interaction. They provide this capability in a more flexible, natural and expressive form. Research has also confirmed that vision is not responsible for the production of gestures. Every human being—even those who are blind from birth—produces hand gesture during the interaction. The gestures produced by the blinds are almost similar to the gestures produced by the sighted users. However, their gestures are limited and less detailed. Although much work has been performed in the human–computer interface, blind and visually impaired users still feel it is difficult for them to interact with the computers.

One of the major stumbling blocks is the lack of knowledge about the hurdles faced by them and their preferences towards hand gestures. This dissertation investigates the hurdles faced by visually impaired in HCI and studies the essential design considerations necessary for developing special interfaces for them. A user evaluation study is performed with them to understand their performance and preference. Based on the outcome of this user evaluation study a novel dactylology is proposed. A recognition module is also presented to recognise these dactylology symbols.

Chapter 1 presents the introduction of the dissertation. The problems faced by visually impaired users while interacting with computers is presented. Some technological solutions to these problems and their feasibility are also discussed. Further, motivation, challenges and research problems are presented in this chapter.

Chapter 2 introduces the preliminaries and system overview in detail. The definition of visual impairment and blindness are introduced. Next, hurdles faced by visually impaired while interacting with computers using assistive devices are discussed. Important blocks of the proposed system and framework of the proposed interactive system are also discussed in this chapter.

Chapter 3 presents the user evaluation study performed with 25 visually impaired users. In this chapter, two measure metrics—performance and preference—measure are proposed to select optimal gestures. Further, a novel dactylology is proposed based on the optimal gestures. The last section of this chapter is devoted to the result and discussion of the user evaluation study.

In Chapter 4, we present a new shape signature—reduced shape signature—for hand gesture classification. Two additional features—difference angle and polygonal area—are also discussed here.

In Chapter 5, we removed the constraint of using a band while posing. This chapter presents a robust wrist point detection algorithm for hand-forearm segmentation.

Chapter 6 presents the summary and conclusions of this dissertation. Future research directions and challenges faced are also discussed in this chapter.

The salient outcomes of the research work have been reported in the international conferences and journals namely, IEEE Transactions on Human-Machine Systems, Pattern Recognition and Pattern Recognition Letters. The author will consider his modest effort a success if it proves to be useful to the visually impaired people of the society.