

Abstract

In this information-driven era, the use of pictorial forms of communication has become widely popular but at the same time making the world increasingly inaccessible to the people with visual impairment and blindness. The lack of accessibility of pictorial information limits the education and employment opportunities of the visually challenged. Access to pictures and diagrams maps such as educational materials, manuals, safety instructions, building layouts, data visualization etc is needed for the visually challenged people for inclusion and independent living.

Tactile diagrams are embossed outline drawings which are specially designed for individuals with visual impairment and blindness to communicate pictorial information through touch. One of the common processes used to prepare these diagrams in polymeric materials is by vacuum thermoforming. Though these diagrams have been in use for many decades, assessing the effectiveness of these diagrams in terms of materials and manufacturability, and its effect on user experience is largely unaddressed. Apart from perceptibility, the diagrams produced are also expected to meet affordability, manufacturability, and biocompatibility. Apart from cognitive aspects of users which is not the subject of this thesis, the perceptibility of these diagrams depends on many factors, which include the type of material used and its properties, sheet thickness, shape, size and texture of tactile features; surface roughness and friction characteristics of the sheet; and the behavior of the sheet to haptic interaction with the user. These aspects have been studied in the current thesis through laboratory experiments, user studies and computer simulations. The specific assessment methodologies developed and discussed in this work include:

- Assessment of material of tactile diagram, in terms of composition and properties before and after thermoforming.
- Assessment of tribological parameters such as surface roughness and friction of tactile diagram sheets.
- Design and development of a methodology for assessment of geometric features of tactile diagram
- Design and development of methodology and a system to assess haptic interaction of users with sheet.
- Assessment of manufacturing realizability and prediction of defects in the thermoforming process through computer simulation.

It is assumed that when the tactile diagrams are produced in large numbers and shop-floor settings, these assessment methodologies proposed, developed and demonstrated in this work will be useful for designers and manufacturers to come up with tactile diagrams that serve the intended purpose effectively by making optimum choices regarding material, manufacturability and user experience.