Tactile Perception and Telematics

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In the context of telematics, the information to be communicated to the human is usually in the form of characters (eg alphanumeric) or graphical representations. To receive this information tactually, various parts of the body can be used; the tongue is the most sensitive part but the fingertips have been found more practical for most communication tasks. There is a significant difference in sensitivity between *active* and *passive* touch; active is where the finger and the stimulator have relative movement. Electrical stimulation has been used in prototype devices but complex control systems are needed for practical applications; the control system is needed since the current required to reach the threshold of detection can quickly cause pain if the transmission characteristics alter (eg perspiration).

The best known alphanumeric tactile code is braille which is based on six dots which gives a maximum of 63 characters (excluding the blank cell). This system is used throughout the world although some languages which have a large number of characters have to use more than one cell to represent each character. In English braille, 190 abbreviations and contractions are used which saves about 25% in the number of cells compared with uncontracted braille. The use of these abbreviations and contractions is governed by a set of rules which depend on pronunciation and meaning; therefore, contracted braille is a language not a code.

One of the problems with conventional braille books is their bulk - typically twenty times the volume of the ink-print equivalent. Therefore a number of devices were developed for storing the braille characters digitally on tape or disc, and then displaying the braille on a transitory display consisting of moveable pins which can be raised or lowered to form a line of braille. These special-purpose paperless braille devices are now being superceded by braille displays connected to standard microcomputers. These systems can be used, via modems, for telematics when only alpanumeric data is being used. A major problem is systems using WIMP (Window, Icon, Mouse, Pointer); no non-visual solution has yet been found to this problem.

Another problem with braille is the small number of people who can read it; there are estimated to be between 10,000 and 15,000 users in Britain where the visually handicapped population is estimated to be about 300,000. There are a number of reasons for the small number of braille readers including:

- a significant cause of visual handicap for those less than 60 years old is diabetic retinopathy which is frequently associated with a poor sense of touch.
- about 75% of the visually handicapped are over 60 years old, and many are not motivated to learn a new system of communication.

- most visually handicapped persons have some *useful* residual vision (what is useful often depends on the specific task being considered).
- in many areas, there is a shortage of skilled staff to teach braille to visually handicapped adults.

A number of tactual languages have been developed based on embossed versions of print capital letters. The only one still in regular use is Moon which was invented by Dr William Moon in 1847. The significance of the Moon code is that it indicates that there may be an unmet need for an embossed language which is simpler than braille for use by:

- less able visually handicapped children who cannot read visually.
- blind persons with a poor sense of touch eg those with diabetic retinopathy.
- older blind and deaf-blind persons who want a language easy to learn by those who have previously read print.

Graphical representations can either be hardcopy or softcopy (ie transitory display). The optimal conversion from a print map or diagram to an embossed version is a subject about which little systematic data is available. Tactual reading of a graphical display has been likened to the visual reading of a large wall map through two pin-holes; the detail has to be read with some form of scanning strategy to build up a concept of the overall image.

Softcopy graphical displays can be a large array of moveable dots (6000 dots would give a page of braille) or a small display which can be moved over an area (eg an Optacon which can be moved over the screen of a visual display unit). Full-page displays are very expensive and they have not been proven to have all the advantages which were claimed; this is probably attributable to the difference between tactual and visual reading of a graphical display mentioned above). Multi-modal displays such as auditory/tactual displays have received little serious attention, but it is likely that they will become increasingly important in the next few years.

Recommendations

1. Research is needed on how a visually disabled person can use computer software designed around WIMPs.

2. Studies are required to quantify the unmet need for an embossed code which is easier to learn than braille.

3. More systematic research is needed on the optimal design of multi-modal displays.