Electronic Aids for the Visually Handicapped

New technology, particularly in the area of microprocessors and microcomputers, has opened up possibilities for new types of aids for the blind and partially sighted. It is not only the dramatic reduction in price of such components, but the much lower development costs which is of great significance for aids required in small quantities.

Those without vision have obvious problems with reading and mobility. It is less obvious that blindness results in a serious lack of privacy; for instance personal financial information may have to be read to one. The general public tends to assume that blind people are those without sight; however over 85% of the legally blind in most developed countries have some useful vision.

Television reading aids. The main technological development for those with residual vision has been closed-circuit television reading aids (Fig 1). These devices usually provide variable magnification, enhanced contrast and image reversal (white letters on a black background), but the disadvantages include the cost (from $1800 to over $4000) and the weight of the machines (typically 25 Kg). Despite these disadvantages they have proved to be very useful aids for those whose needs have not been met by conventional optical aids.

(insert Figure 1 here)

Tape recorders. For users with no useful residual vision, aids for access to written information have either audio or tactual output. Probably the most useful technical aid is the cassette tape recorder. The main disadvantages are the user's inability to vary the speed, and the lack of a good indexing system. The variable speed problem can be overcome by using 'compressed speech' modules which correct the pitch changes resulting from

increasing the speed. This is done by sampling the signal and discarding some of the samples; the electronic processing links the remaining samples without unpleasant transients. Another application of this technology is audio communication with deep-sea divers who are breathing helium; the helium makes their voices very high pitched and difficult to understand.

The indexing problem is not so easily solved. What is required is an inexpensive system so that the blind user can input a number or keyword, and the machine will then automatically find the information; such systems exist but they are prohibitively expensive. A less satisfactory solution is to record index terms on another track but this is laborious to use.

Synthetic speech. A variety of devices with speech output are now commercially available. The simplest use spelled speech where the output is character by character; the advantage is the very low cost, but the quality is unacceptably low for any application involving prolonged listening. The quality of full vocabulary synthetic speech, where the machine approximates a human speaker, is dependent on the size of the computer program, but high quality synthetic speech systems are still expensive.

The major breakthrough has been in the medium quality systems; there are now a large number of full-vocabulary speech output devices with computer interfaces with prices from $150. These devices are very useful for blind people wanting a file read out and being prepared to tolerate the Dalek-like speech. However many blind people want to use a microcomputer in a word-processing mode; the available speech terminals, with cursor information, cost in the order of $5000 which is a large increment in cost for a small increment in performance.

A reading machine with optical character recognition and synthetic speech output permits a blind person to have direct access to printed books, but costs in the region of $30,000; costed over five years, it might be cheaper to employ a sighted reader. However the cost of such machines should decrease

significantly over the next few years.

Braille. The best known communication medium for the blind is braille where dots are embossed on paper or plastic. The system was developed over 150 years ago by a blind Frenchman Louis Braille. Braille utilises a six dot cell giving sixty-four possible combinations. One of the disadvantages of braille is the considerable bulk which is typically twenty times that of the print version. To reduce this bulk, 190 contractions and abbreviations are used which result in 25% saving in space. There is an acute shortage of people skilled in transcribing braille, so a number of computer-based systems have been developed to translate text to contracted braille. Such systems permit a typist with no knowledge of braille to produce documents in both ink-print and contracted braille from a single typing operation (Fig. 2).

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Computer-based systems are significantly cheaper than manual transcription for information which already exists in digital form. For instance major banks in the UK use an automated system to produce statments of account in braille. Since the system is totally automated it also minimises the risk of an error in the braille version.

Braille has not been superceded by other forms of non-visual media despite numerous predictions to the contrary; braille is still supreme in its use for reference and technical material. Another important aspect is that a blind person can write braille without having to invest in expensive equipment.

A number of systems have been developed for storing braille digitally on cassette or floppy disc. The braille is output on a transitory display such as an array of pins which can be raised to represent the braille characters. These devices typically cost $7500, so they are beyond the reach of most blind people for use at home.

Reading machines. Devices have been developed for converting printed characters to some form of tactual output. Most of these devices do not recognise the characters but present a tactual display which has to be recognised by the human reader. The most widely used is the Optacon which gives an enlarged tactual image of the letter being scanned (Fig 3). The advantage of this device is that it can be used on any printed or typewritten material. The disadvantages are the considerable training and practice required to reach speeds of 50 words per minute, and the cost of about $4500.

Large print. As mentioned earlier most of the legally blind have residual vision, but it is only very recently that modern technology has been used to produce reading material for this group. The most notable development has been the application of laser printers for the fast production of large or 'clear' print. A laser printer is capable, with special computer programs, to produce good quality print of any size at speeds up to four pages per second. Another method to produce clear print is to use a matrix printer with up to 12 passes for each line; the matrix is offset each pass and the end result is a very clear bold image, but the printing speed is slow (typically 13 characters per second).

Electronic mobility aids. The traditional mobility aids for the blind are the long cane and the guide dog. The long cane has the advantages of simplicity and cheapness; it can be a very effective mobility aid with the proper training, but it does not provide the user with any warning of obstacles at head height. Electronic aids can be used as a supplement to a long cane by providing an audio or tactile warning of such obstacles.

The electronic aids are usually obstacle detectors or environemntal sensors. The former just indicate whether there is an obstacle within range; for instance the device may give out