WORKING NOTE AC45

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An intelligent interface for the disabled.

Preamble.

It is clear that many disabled people can make profitable use of computers, once they are able to communicate effectively with the machines. Those who retain a good measure of manual dexterity can use ordinary keyboards, but others may have more or less serious difficulty, depending on the nature and extent of their disabilities.

Various stratagems have been devised to circumvent the difficulties in specific cases – for example, some use special probes to operate keyboards, or arrangements are made to select words or phrases by directing a cursor to an appropriate position on a screen. While such means are, obviously, better than nothing, many seem clumsy. Perhaps this is inevitable, for they are largely expedients to which people are driven in order to use machinery which is not designed to fit them.

The principle of fitting the machine to the user is important. The widespread use of keyboards is a case in point : keyboards work more or less well in most circumstances because most people conform to the standard pattern for which the keyboards are constructed. Disabled people may not conform to any such pattern; indeed, while some classes of disability are more common than others, there is no part of the body which is immune from damage, so there cannot be a single pattern which fits everyone.

This argument suggests that satisfactory solutions are only likely to be attained if each person is considered individually, and provided with an individually designed interface. While this would clearly be highly desirable in principle, it would equally clearly be exceedingly expensive in practice. In fact, though, that is not the only solution : it is possible to achieve individual treatment even from standard machinery if the machinery is sufficiently "intelligent" to react differently (and appropriately !) to different stimuli.

Proposal.

To make this approach work, the first requirement is for some form of transducer from which anyone can generate some sort of signal – though it is unimportant whether different people generate the same signals. For example, it should be possible to devise an interface, or a small set of interfaces, which are in effect simply motion transducers, able to detect muscular movements when placed against the skin, and to translate these into patterns of binary digits. To fix ideas, I have found it useful to think of a pad which can be applied to any part of the body, and which can generate a set of signals which reflect in some way any motion which occurs.

A second requirement is for computer software which can be used to interpret the signals received from the interface device. As the signals will not in general be of predictable form, it is unlikely to be possible to provide complete specifications of the input as hard code within the programme; it is therefore necessary to use some sort of learning programme, which will adapt itself to each person who uses the equipment. By this means, the essential requirement of unique matching between system and user can be attained without incurring the prohibitive costs of constructing each such system individually, whether in hardware or software.

Is this approach feasible ? I believe that it is. The task involved is in many ways similar to that of recognising speech input, for which packaged systems are now becoming available. There are two major differences between the two tasks. First, the signals to be recognised in this proposal are

quite unpredictable : in speech recognition work, there is at least a general understanding of the form of signal to be expected, and some consequent basis on which to erect a skeletal recognising system. On this count, my proposal is perhaps harder than speech recognition. Second, though, the signals themselves as generated by the interface device can be made far simpler than speech signals. It is not necessary to be able to cope with a highly complex analogue input waveform; the device can be constructed to return a digital indication of its conformation.

Scenario.

As an illustration of how the system might work, and also to point out some possible areas of difficulty, here is a little science fiction.

Q has just been presented with an IDEA (Intelligent Device for Enlarging Abilities). The sensor pad has been strapped on to an area of Q's body in which some reasonable degree of muscular control remains. First comes the initial learning phase : Q must teach the IDEA an alphabet. IDEA presents a letter A on its screen; Q responds with a motion or sequence of motions. IDEA presents B; Q responds again. This continues, with frequent recapitulation to make sure that the early symbols are not forgotten, and also with possible requests from IDEA to define a different symbol because the one given is indistinguishable from one already stored. (This could take a long time; doubtless a lot of work has already been done in this area, and better ways of establishing communication have been devised – for example, it might be better to begin with words or pictures rather than individual letters, so as to establish a useful vocabulary quicker.)

With a basic vocabulary established, the adapting phase begins. As Q gets used to the new way of doing things, communication speeds will rise; the detailed forms of the code will become less precisely formed – just as legible printing becomes less legible handwriting as you learn to write more quickly. The system should be able to adapt to this change by itself, only asking for clarification in cases of real ambiguity. This is a lot harder, but I believe that it's a realistic long-term aim. It should also be possible to define "shorthand" codes for common words or other objects.

It then becomes possible to think of driving other machinery through the computer. Further vocabulary will be necessary, and clearly more software will be needed; but no really new problems are evident.

Difficulties.

I do not make light of the difficulties attached to my proposal, but I do believe that there is a reasonable prospect of some degree of success. To some extent, the difficulty to be encountered depends on expectations. If the aim is to produce a near-human aide, able to identify and react correctly to any stimulus it receives, then the task is indeed difficult; on the other hand, if the aim is, more modestly, to provide a substitute for a typewriter keyboard for people who are unable to use one, then the target becomes more attainable.

I believe, in fact, that it should be possible to get rather further than a simple keyboard substitute – but that seems a sensible initial goal, and I don't know enough about how that might work to propose anything more elaborate.

It is also worth remarking that not all the difficulties are technical. How do you teach someone to design an alphabet ? Q's alphabet will be known only to Q and to the computer; and not even the computer can remind Q of forgotten symbols, because it has no way of translating the symbols back into muscular actions. This may be the biggest difficulty of the lot.