WORKING NOTE D1

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NOTES ON POSSIBLE USES FOR COMPUTERS AT THE WILSON HOME

PREAMBLE.

WHY I AM WRITING THIS.

- To sort out my own ideas on the subject. If a lot of it seems obvious, elementary, or irrelevant, that's because I'm trying to write down a reasonably complete account of things as I see them for my own benefit. (That also accounts for the plethora of references : it's not an attempt to appear authoritative, just a way to remember.)

- To present some ideas as an encouragement to further discussion. It often seems that people ask for too little because they don't know what can be done; this is perhaps particularly true as it relates to computers, of which rather few people have any but fleeting experience (6).

- To find something for me to do. All the suggestions I make later are practicable, and I would like to be able to contribute to the Wilson Home's work by getting one of them – or something else along these lines – going.

(The remainder of the "PREAMBLE" is a personal note, in which I try to set out my position as I see it. I think it's important to get such things clear.)

NOT WHY I AM WRITING THIS.

It is absolutely not my intention to impose my ideas on anyone. I am not some sort of whizz kid who wants to drag you kicking and screaming into the twentyfirst century; nor do I have romantic notions of myself as a latter-day Florence Nightingale, spreading sweetness and light to the grateful masses.

I am also aware of the dangers of being a solution looking for a problem (2). Any bright ideas which I may have are useless unless they fit your children's problems, and I would expect you to tell me so.

That said, I have skills which I believe could be useful in exploiting the capabilities of computers to help people with disabilities to communicate and to control the world around them; I'm just looking for some way to put those skills to good use.

WHY THE WILSON HOME ?

Because it's there. More precisely : because just at the time when I had decided to seek some opportunity for using my expertise to help disabled people, we became aware that the Wilson Home had some experience of computers, and was in need of help.

It may be that we shall find that I have nothing to offer the Wilson Home; if that's so, then it's best to find out as soon as possible, so that I can start looking elsewhere.

SURVEY.

AVAILABLE HARDWARE.

You can buy a **microcomputer** for less than $200; there is no upper limit, but if you stay with microcomputers, then $10000 will buy you a very ambitious system. The microprocessor itself can cost less than $10, which means that special purpose computers, or auxiliary attachments to existing machines, need not be expensive to construct.

The usual **input device** is a keyboard, though this is increasingly often now augmented with some sort of "pointing" device, such as a joystick or mouse. You are probably better aware than I of the range of paddles, switches, and adaptive devices which have been specially developed for disabled people (4, 15). It is probably true to say that one could use any physical movement as the basis of some sort of computer input device. Devices relying on eye movements (4), sucking and blowing (15), and collecting neuroelectrical signals from the skin (8) have been constructed. Sound can be used to some extent, though analysis of connected speech is so far not possible.

Output is usually directed to a screen or a printer, but again many other devices are available. Quite effective speech synthesisers (7) can now be obtained, many quite modest machines provide several musical tone generators as a matter of course (10), and, with appropriate linkages, computers can be attached to pretty well any sort of machinery that can be controlled by electrical means. Now that quite cheap robotic arms ($500 up) are becoming available, even the restriction to electrical control is becoming less severe.

AVAILABLE SOFTWARE.

To survey the whole field of microcomputer software would be difficult, and is certainly not an inviting prospect : roughly speaking, if it's possible, then someone, somewhere, has written a programme to do it.

Given that the quantity is prodigious, though, the quality frequently leaves much to be desired. Some archetypes can be discerned :

- The more expensive packages – typically those designed for small business applications – are often very well designed, robust, and very easy to use. They cost the earth, but they show what can be done if you really want to.

- The manufacturers' software is sometimes of the same high quality, but ranges down to frankly shoddy. This is particularly noticeable at the lower end of the price range, where system failures may be quite common : the guiding principle seems to be that whoever is using the computer is either a computer expert (assumed to be unlikely to make mistakes, and competent to sort out the mess if there is one), a computer freak, or playing games, so it doesn't much matter if the system has to be restarted from time to time.

- Some of the less ambitious packages have been put together on the assumption that they will always be used by computer experts (which is a problem with software for big machines too !): they make few concessions to the inexperienced, and may rely on arcane system knowledge to perform certain functions. ("Everyone knows that ^Z means end-of-file. Everyone, for that matter, knows what end-of-file means.")

- There is a lot of software in the cheap-to-free range which has been written by enthusiastic and well-meaning amateurs, and shows it. It is badly written, prone to failure, and comes with no documentation, except possibly for a "list of known bugs".

It is often very hard to acquire adequate documentation, except for the professional packages and, to some degree, the manufacturers' software. Source code (which you probably need if you intend to modify the programme in any way – say, to use some special input device (3)) may or may not be available; for the professional packages, you commonly have to pay quite

a lot to get it if it's available at all, and it's then all hedged about with copyright conditions and the like.

COMPATIBILITY.

This quality is noteworthy mainly for its rarity. It is almost true to say that all microcomputers are different; programmes written for one machine will rarely work on another without modification, discs written by one system are usually unreadable on another, and uniform treatment of peripheral devices – particularly unusual peripheral devices – is uncommon.

This pervasive gloom is dimly illuminated by the existence of a few common operating systems (CP/M, MS/DOS, Xenix) and by the appearance of many "PC-compatible" machines in the wake of the inexplicably successful IBM personal computer.

On top of all this, the rapid development of microcomputers continues. One can argue that this very fact accounts for, and even renders desirable, the widespread incompatibility between systems : if compatibility is ever achieved, then may we not be shackled to some standard which is likely to be outdated even before it is formulated ? At the same time, it creates serious problems in keeping software up to date : this is particularly true with packages which have been patched, perhaps to use a special peripheral device. In general, such modifications will have to be repeated for each new version of the software as it is produced, or the programme simply becomes unusable (3).

PROSPECTS.

To venture prediction in the field of microcomputers is to venture onto very thin ice indeed, but some trends seem fairly clear.

The electronic components continue to become cheaper and more reliable. This suggests that very simple computers will become even cheaper, and probably rather more ambitious too. More powerful machines with more sophisticated operating systems will appear in the middle price range; in particular, "object-oriented" systems modelled on the Smalltalk pattern and able to run several processes simultaneously will become readily available. (The Apple Macintosh is a forerunner of this breed.)

It will be possible to use very large memories, both primary (internal) and secondary (disc). Size constraints on programmes will effectively disappear; it will no longer be possible to excuse sloppy programming as necessary to conserve memory space. Video disc technology will put gigabytes of secondary memory within the reach of even modest computers – and will also, together with improved graphics hardware and screen handling techniques, lead to storage, retrieval, and computer manipulation of pictures.

Speech synthesis will continue to improve, and become cheaper – but satisfactory speech understanding is probably still some way off. Perhaps a moderate ability to interpret disconnected speech (one word at a time) will become possible within a few years, but analysis of natural speech patterns is much harder.

The prospects in the software field are even less easy to foresee. One major step, though, is likely to be in the design of operating systems. Present systems are modelled on traditional lines, based on ideas developed in the early days of large computer systems : they are simply ways to allow people to run programmes. Future systems are likely to concern themselves much more with data than with programmes, leading once again to the "object-oriented" system. The needs and convenience of the person using the system are beginning to receive more attention. Traditionally, the convenience of people has come a very bad second to the efficiency of the machine, but attitudes are now changing. I expect to see easier and less formal ways of controlling the system, which don't require people to learn a strange " command language"; for those who don't know how to get what they want, the system will provide help on request. Developments along these lines are already possible to some extent, and can be seen in such systems as Smalltalk and the Apple Macintosh; a much broader application of the principles can be expected, though, drawing on increasing abilities in the field of Artificial Intelligence, both to understand what the human tells the machine, and to build up a model of the human's understanding so that responses can be constructed at the appropriate level of sophistication.

REVIEW.

It is perhaps clear from the tone of the previous sections that I am not favourably impressed by the state of much of today's microcomputer industry.

The rapid development of the **hardware**, both in processors and in peripherals, is not always guided by wisdom, though it's always exciting ! It is also fast. There is nothing we can do about that, even if we wanted to, but we can try to find ways to make sure that the software we produce will run on as wide a range as possible of machines available today, and will still run on machines of the future. We would like to be able to take advantage of improvements in the underlying microprocessor technology as they appear, and also to ensure that our programmes will easily be able to adapt to new peripheral devices.

In the matter of **software**, the commercial packages, and many of the better designed games, have shown that it's possible to produce software which doesn't break down, is easy to use, and is tolerant of mistakes. It seems, though, that the only way to achieve such high standards is to have your programmes written by highly paid professionals (as in the packages) – or to inveigle amateurs into the task by holding out promises of even more money in the future (the games). Failing that, you have to do it yourself – which has a number of advantages (your programme is easy to adapt to new circumstances, you have the source code, there are no copyright problems or fees to pay), but requires knowledge and time.

What can we say about the specific topic of computing for disabled people ?

I should first make it quite clear that my comments are made from a position of profound ignorance, on the basis of a few conversations, a cursory glance at some lists of available software, and some surveys of work done here and overseas. Accepting that, though, my impression is that the position is not encouraging. There are a lot of programmes about, but too many seem to be of the well-meaning amateur type : fairly limited, inflexible, less than completely reliable, tied to a particular machine, not designed for inexpert users, and poorly, if at all, documented. Because of this, the person using the computer may be stuck with a single, not very exciting, programme (or, worse, with a SYNTAX ERROR message) until some able helper comes along to do something about it; or an investment in software may tie one to a particular brand of machine, even when other machines are better or available at a much lower price; or programmes may have to be rewritten to cater for minor changes in the mode of display or peripheral devices required.

I am, of course, not the first to notice these phenomena. The need for coordination and standardisation has been recognised [5,13] – which is not to say that these desirable ideals have been achieved. Another clearly defined need is for facilities which allow the disabled person to use programmes – ideally, *any* programmes [1] – not originally written for the disabled; again, the need has been addressed [3,11], but can hardly be said to have been satisfactorily met. I have not seen any explicit mention of the need for a highly reliable operating system, able always to recover from faulty programmes, and with a range of control languages which can cater for anyone from young children to experienced adults.

SUGGESTIONS.

With all that said, it is far from easy to identify tasks where I can make a useful contribution without tripping over, or getting in the way of, people already doing useful work; or setting up systems which render useless lots of existing programmes; or perpetuating the very ills which I've identified as dangerous. There are certain constraints on the sort of thing I can do : it has to be doable at odd hours, because I have a demanding full-time job; and that in turn implies that I would find it difficult to take part in any team effort, so I have to find something which I can do independently of anyone else. This attempt at analysis has suggested some largish long-term projects, which I shall write down in other Working Notes. (There is some point in doing so. The bigger projects are taxing enough for me to offer to a student as a research topic, so they stand a real chance of being done; but I would only wish to do that if I were assured of cooperation from the Wilson Home, or some other organisation where the techniques could be tried out in practice.) For my own present purposes, these are too demanding of time and effort; but smaller immediate projects are harder to invent. Nevertheless, here are a few.

- o A wheelchair-mounted communicator [12]. Using a smallish computer and a simple character display, it should be possible to fit all the components of a simple "sentence-building" communicator onto a wheelchair. (This has, in fact, already been accomplished [2], so it can certainly be done.)

- o Investigate using cheaper computers [9,11]. (The previous suggestion is one possible field of application !) Do you really need Apples ? Smaller and cheaper machines are available. Does every computer need a disc drive ? Perhaps one drive could be shared by several machines.

- o Look at simple robotic devices. (This is one of the more extended projects too, but it really isn't hard to construct simple manipulators.) A simple pick-up-and-fetch robot is not hard to make. There are other simple tasks which might usefully be automated : picking things up from the floor, switching lights on and off, opening doors. It's worth commenting that this sort of thing would probably be good fun for those using the machines – especially during the development stages !

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– and that's a blank for *your* ideas. You know what's needed : I don't. What I do know is something of what's possible. What science fiction fantasies would you really like ? Even suggestions which aren't practicable now may point the way to useful directions in which to make a start.

REFERENCES

MBS B.T. McMahon, E.J. Burkhead, J.P. Sampson : "*Computer access and applications to career counseling with vocational rehabilitation clients*" (D:ATA Institute, The Catholic University of America, Washington DC, 1985)

NAR "*National annual reports from the International Project on Communication Aids for the Speech-impaired*" (University Center for International Rehabilitation, Michigan State University, 1983)

AC Adrianne Cranshaw : "*Computer use by disabled people*" (New Zealand Council for Educational Research, 1985)

(1) MBS p24, NAR pp 88, 111.
(2) MBS p25.
(3) MBS p27
(4) MBS p44.
(5) MBS p31, NAR p40.
(6) MBS p36.
(7) NAR pp 7, 38, 103, 108.
(8) NAR p44.
(9) NAR p47.
(10) NAR p48.
(11) NAR p86.
(12) NAR p106.
(13) AC p3.
(14) AC p9.
(15) AC p16.