COMPUTER-BASED ASSISTANCE FOR THE BLIND AT THE UNIVERSITY OF MANITOBA

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PROGRAMMING COURSE FOR THE BLIND

The University of Manitoba established a course to train blind persons as computer programmers in 1965. Since a one-year training course does not fit into the normal University academic pattern, this course was established as part of the Computer Centre, which is a non-academic service department of the University. Upon successful completion of this non-credit course, a student is issued a certificate, and over 60 graduates are currently employed as computer programmers.(1)

Applicants for this course are expected to have some academic training at the University level (preferably a degree), and pay tution fees. These fees are typically subsidized by rehabilitation and training programs, and this income is the only source of funds for the course. Because of stringent budget constraints, and the fact that it is not a regular academic program, the University of Manitoba provides no direct financial assistance for this course. However, the Computer Centre does provide office space and computer time, as well as administrative assistance and quidance.

The Supervisor of the Programming Course for the Blind reports to the Director of the Computer Centre, who is responsible for budgetary control, and must approve student marks and pass/fail decisions before they are issued. The course Supervisor is responsible for curriculum, teaching, and the detailed operation of the course.

The course begins with an introduction to computing concepts and assembly language programming. The student then studies the COBOL language and must complete 12 to 15 programming assignments. Other topics studied include the PL/1 programming language, flow-charting and documentation, as well as practical experience in the use of text editing and information retrieval systems. The course usually concludes with a month of practical experience at the employer's computer installation.

Since its inception, the Programming Course for the Blind has been extremely successful. Over 90% of its graduates are gainfully employed and paying taxes rather than receiving disability pensions. During his working career, a blind programmer would likely pay taxes equal to twice the amount he would receive on a disability pension.

BRAILLE TRANSCRIPTION SERVICE

In the past, volunteer workers have frequently been used to type braille copies of printed material. A major difficulty is that the worker requires extensive training in order to use a braille embosser. In addition, normal typing of braille is an extremely slow process, especially for an inexperienced operator.

The staff of the Programming Course for the Blind have extensive experience in the field of braille production by computer. Students in the course type their programs into a large computer, and the results are typed out in braille by an MIT braille embosser.[2] This device has also been used to transcribe French texts to braille with extremely gratifying results.[3]

The use of a computer can greatly simplify the transcription of normal printed text to braille. A sighted person simply types in text using a typewriter terminal connected to a computer. The information is stored by the computer, and then translated into braille code by the DOTSYS III computer program.[4] Another computer program then drives a special device to produce an equivalent braille text on paper. Thus, a volunteer worker need only be trained to use a standard typewriter keyboard, with a resulting decrease in training requirements, and an increase in speed. In addition, a copy of the information may be retained in computer storage, and used to produce new braille copies whenever desired.

At the beginning of 1974, the Computer Centre began producing braille textbooks for public school students. Blind students in the Province of Manitoba are taught in the public schools rather than in specialized schools for the handicapped, and the availability of braille versions of the required textbooks had traditionally been a problem. Over the summer of 1974, the required texts were punched onto cards by part-time employees, and entered into on-line files. An interactive text editing system was then used to correct the text as data entry errors were discovered by proof reading. These files were then translated into standard braille text by the DOTSYS program, and the output listed on a triformation LED-120 braille output device to produce a high quality braille textbook. The machine readable text was then saved on magnetic tape so that further copies could be produced on request. During the summer of 1974, over 250 volumes of braille text containing over 16,000 braille pages were made available to visually handicapped

students in public schools. It would have been impossible to satisfy this requirement in the time available by any other means. The DOTSYS program was also extended by a graduate student to handle the Nemeth code used to represent mathematical symbols and expressions. A number of agencies and organizations all over North America requested information and copies of the software, and some began to request copies of the braille text produced.

The amount and variety of braille texts produced increased dramatically in 1975. Between May and October of that year, 125 books were transcribed, producing about 600 braille volumes comprising almost 40,000 pages. The acceptance of this service is also indicated by the fact that further requests for braille versions of textbooks are continuing to arrive at a rate of almost 5 per week. This huge volume of braille transcription was made possible by improvements and extensions to the DOTSYS program, which is being distributed to other agencies. Improvements in clerical procedure and increased staff experience over 1974 also played a major role in allowing such a rapid increase in volume to be accomplished. By the end of the summer, the braille transcription service was consistently producing about 3 entire volumes every working day, and can transcribe an entire book within one week. To our knowledge, no other method of braille production can approach this rate of production and response time, while producing accurate and error-free braille text of high quality.

Research Projects

During 1974, an inexpensive audio response unit was purchased to be used for research purposes. Initial investigations were directed towards assisting blind programmers with the use of general purpose interactive computer systems. The initial software was developed to echo each input and output character as it was typed. An autocall adaptor was also obtained to allow audio output to be transmitted over telephone lines.

During 1975, software was also developed to allow computer output to be spoken as words by the audio response system rather than being spelled charachter by character. However, definition of a vocabulary of words expressed as sequences of phonemes proved extremely difficult for staff with no background in linguistics and phonetics was therefore employed during the summer of 1975. The success of this project is illustrated by the fact that a vocabulary containing in excess of 1000 words was produced, rather than the expected number

of approximately 500 words. Even more important is the fact that a blind employee or student with a small amount of training can now use general purpose interactive systems at the University of Manitoba with the same productivity as his or her sighted colleagues. These persons can also now work independently, rather than requiring the assistance of a sighted person to read output from the terminal. A vast amount of experience was also obtained concerning the generation of audio response vocabularies and phonetic rules, and a guide on this subject has been developed.[5]

It is obviously a duplication of effort if an organization should produce materials for the visually handicapped that have already been produced elsewhere. The University of Manitoba therefore began the development of a catalogue of such materials in 1975. Initially, this catalogue lists materials produced by the University of Manitoba and the Canadian National Institute for the Blind. Arrangements have also been made to include an index compiled by the Crane Library at the University of British Columbia in this catalogue. The availability of a current catalogue of materials available and under development should prove invaluable to agencies assisting the blind.

Conclusions and Further Work

A major conclusion is that computer-based transcription of text materials into braille is not only a viable application, but has proved to be invaluable in the timely production of accurate texts for students. The techniques and procedures required to perform this function have been developed and are operating successfully. The only limitations on the quantity of braille produced are the speed and number of staff entering the input, and the speed and number of devices producing the braille output. Preliminary investigations indicate that the former bottleneck might be solved by using magnetic tapes produced during the computerized typesetting process, but this approach is complicated by the fact that each different publisher may use different standards and conventions. Further investigation is required in this area.

In the past, blind persons have had limited access to braille versions of school texts, and recreational materials

such as novels, magazines, and newspapers have been relatively scarce. The current braille transcription service is oriented towards the production of school texts, and therefore the number of copies of each text required per year is quite small. However a large number of copies of recreational materials are required. Some initial analysis has been made of requirements in this area, and initial results indicate that only a few hundred copies of a single monthly magazine could be produced using the current output device. Although such an operation would help a small fraction of the blind population to have access to recreational materials, this approach would seem extremely cumbersome and time consuming. In order to effectively provide recreational materials in any quantity, a much faster braille output device would be required. One possible approach might be to investigate the possibility of an electrostatic printer depositing sufficient volumes of material on the output page to be felt by the fingers of a blind person. If this approach were feasible, it might be possible to use a slightly modified printing subsystem to produce recreational braille materials at high speed.

Even with the amount of material available today for the blind, duplication of efforts is a distinct possibility. As the amount of material increases, this probability will increase, as will the effort involved in locating materials which have already been developed. A comprehensive database concerning the materials already available or under development and their sources is required. Given the decreasing costs of communication, it may be economically feasible to provide interactive access to such a database from each centre requiring or actively producing such materials.

The work done so far has demonstrated the feasibility and value of audio output to enable a blind computer programmer to operate almost as effectively as his or her sighted colleagues. However, only a small number of computer systems have an audio output capability, and it is most unlikely that such a service would be added to a general purpose computer system to satisfy the requirements of one or a few blind persons. An alternate approach would be to supply a blind programmer with a terminal communicating to a central system in a standard communication protocol. However, instead of printing or displaying computer output, a microcomputer in the terminal would translate each output word to the equivalent sequence of phonemes and drive a loudspeaker. Equipped with this type of terminal, a blind person could access any computer system supporting interactive access, and no system modifications or other equipment would be required. Such a terminal should be extremely portable and might be useful in other applications as well.

References

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