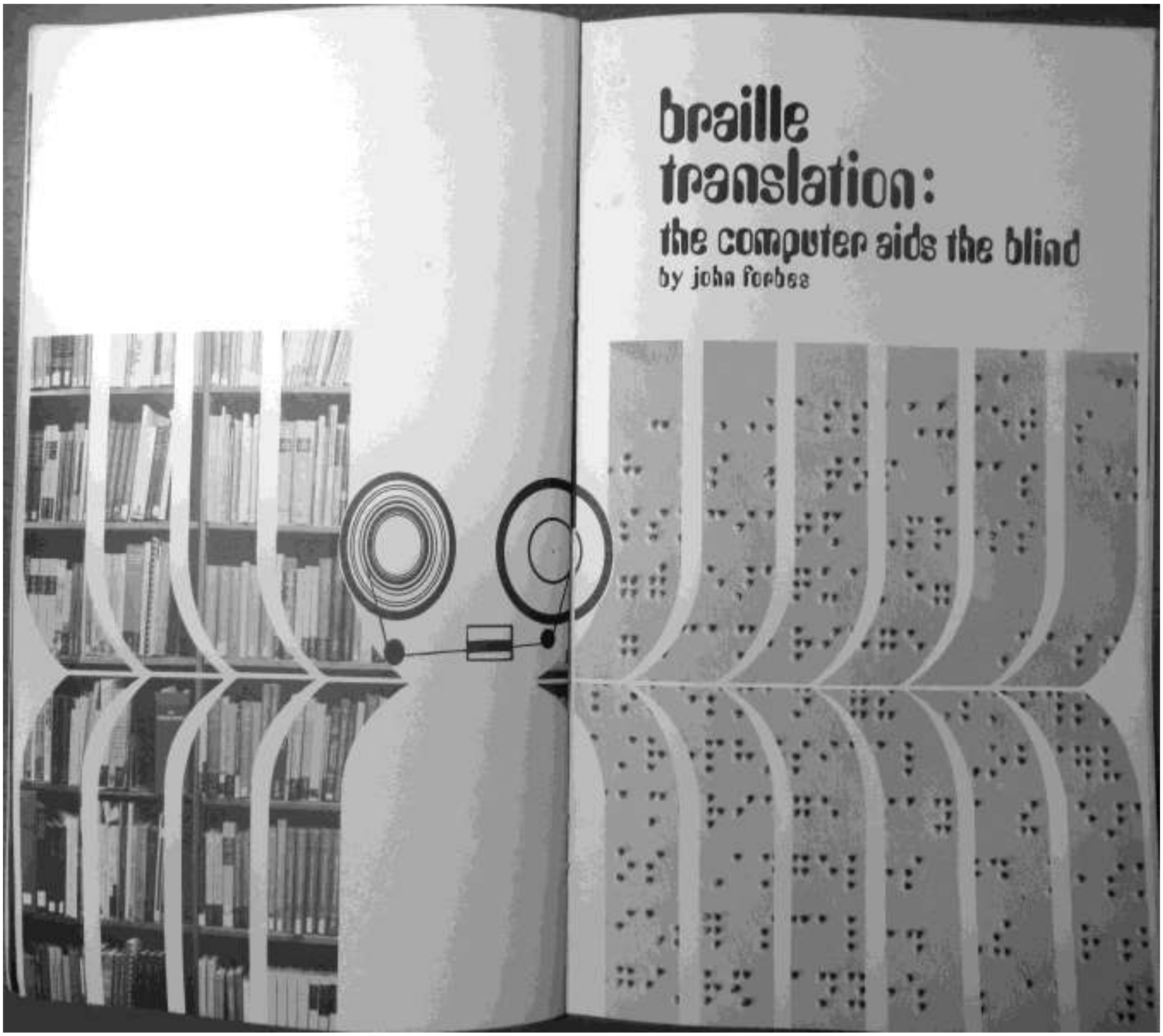
Mitre Matrix Volume 5, number 2

Braille Translation



Unfortunately the pattern of assistance to the handicapped in terms of sensory and educational aids has lagged badly — especially when one considers the technological achievements of the past 25 years. Industry has been inhibited in the development of such aids by the small size of the market, and dwindling research funds have slowed development in independent research firms.

One of the bright spots, however, is in Atlanta, Georgia where the Atlanta Public School System has been busily engaged in improving the calibre of its educational program for blind students. The Massachusetts Institute of Technology and The MITRE Corporation assisted these efforts with a computer program that helps blind students to participate in the same classes as sighted students.

Assuming the lead in one of the nation's most advanced educational programs, the Atlanta Public School System a year ago took a major step by integrating classes with blind students and sighted students.

Aimed at helping the blind to participate more fully in society, the program is now well rooted with 28 blind students participating successfully in grades one through twelve.

Success of the program is based on the availability of "instant" Braille produced from a program run on an IBM 360 computer. Every day each of the blind students gets a Braille text of that day's classwork so he can study and learn in the same room and from the same sources as his sighted classmates.

The smooth running program now underway in Atlanta is the result of a cooperative effort that included the Atlanta Public School's Computer Braille Project, MIT's Sensory Aids Evaluation and Development Center and The MITRE Corporation's Intelligence and Information Systems Department. Dr. Marion Boyles, who serves as Director of Atlanta's Computer Braille Project, has already termed the project a success even though it is still relatively young. Dr. Boyles reports that to date approximately 12,000 pages of Braille text have been produced. In addition, the publicity given the project has stirred interest around the world. She has received many requests for information from people in and out of education who are conceiving different applications for this new computer-produced Braille.

Advantages

Robert A. Gildea, Project Leader for MITRE's part of the effort — the writing of the computer program — points out that computer-produced Braille is not in itself new. But MITRE's upgraded version for Braille

Expanding the limits of the lexicon, Reid Gerhart (left) and Joseph Sullivan examine a proof printout of words and contractions and their Braille counterparts.

Vito Proscia, MIT, and Robert Gildea check the product of the Braillembosser.

Evelyn Welsh, Administrative Assistant, MIT, types copy into the computer for translation into Braille.

translation represents a significant advance over what had been available.

Previously, blind students were restricted to a limited number of subjects for which there were Braille versions of the text. Now, Braille texts can be produced immediately to cover virtually any need. For example, one blind girl in Atlanta has been able to take a course in Oceanography, since the necessary texts were easily and quickly produced by the computer.

Essentially the system operating in Atlanta provides students, on a daily basis, with Braille editions of the text material, homework assignments, reading excerpts, etc., that their sighted fellow students receive. A keyboard entry device is used to input the text to the computer. The computer does the translation and the output information is provided on magnetic tape. The tape is subsequently fed into a line printer which has been modified to emboss Braille. To facilitate classroom work most of the Braille text and other material is run as a batch process each night so it will be ready for the next day's classes.

Background

Tracing the historical development of the Atlanta system reveals considerable achievement in a relatively short period of time. In the late summer of 1969, MITRE's Bob Gildea talked to Mr. Vito Proscia, Director of MIT's Sensory Aids Evaluation and Development Center, about the possibility of writing a Braille translation program in a higher level computer language. (There was a Braille translation program which had been developed earlier at MIT called DOTSYS, for Dot System.)

A key feature of Gildea's proposed program would be its "portability" – the ability of the program to run without modification on many different computers. Gildea himself is legally blind and so is well acquainted with the problems of the blind.

The outgrowth of this conversation was a demonstration of an interim version of a Braille translation program (given the designation DOTSYS II), developed for MIT by MITRE's Dr. Jonathan Millen and Reid Gerhart.

In the meantime MIT, which had been active in hardware and software development in this area since the early 1960s, initiated conversations with the Atlanta Public School Board aimed at improving Atlanta's ability to produce literary Braille. MITRE's interim computer program became the keystone in a new project at MIT for the Atlanta School Board. Still to be accomplished was the upgrading of the interim program. This new computer program was completed by MITRE's Joseph E. Sullivan and Reid Gerhart in the summer of 1970, and the completed system was installed and was operating in Atlanta by October.

There were two primary upgrading efforts. The first was the extension of Braille translation to a much larger number of English words. The second was the addition of features which produce Braille output corresponding to the printed text formats. These features include running chapter headings at the top of each page; centering titles; inserting codes within the Braille text which identify the start of new printed text pages; and the ability to present poetry in Braille.

Further work by MITRE for MIT provided the capability for "instant" Braille using a remote terminal connected on line to a time-shared computer. Called DOTSYS III, the program that emerged embodied many significant improvements over previous Braille translation programs.

What eventually proved to be the cornerstone of success of DOTSYS III was the choice of COBOL as the higher level language. Originally ten higher level languages were considered for the

The message is in the medium. Robert Gildea, Project Leader, (left) and Dr. Jonathan Millen compare notes in Braille and print.

program – ALGOL, APL, COBOL, COMIT, FORTRAN IV, JOVIAL, LISP 1.5, PL/1, SNOBOL and TRAC. Four criteria were adopted against which each of the above languages was measured.

These criteria were transferability, clarity, efficiency and the ability to implement the program on the IBM 360. Transferability was defined as the ability to run the program on computer systems other than the one on which the program was debugged. Clarity was defined as the ability of programmers other than the author of the program, to determine from reading the program where to make any necessary changes.

COBOL and FORTRAN were the only two languages which qualified against measures of clarity, transferability and implementation. The choice then depended on which proved more efficient. Running a benchmark test program in both languages showed that the FORTRAN version required 28,696 bytes while COBOL required only 6,260 bytes. In addition, the FORTRAN program processed 5500 words of text at a rate of 676 words per minute while the processing rate for the same text in the COBOL version was 2070 words per minute.

Problems and Promises

The construction of DOTSYS III was not without its problems and drawbacks. Braille as it is used today, in almost all contexts other than special textbooks, is almost a system of shorthand and not simply a scheme for representing individual inkprint symbols in a tactile code. Standard literary Braille alone has 189 contractions. Cases routinely arise that are easy for a human transcriber, but still difficult for an essentially mechanical process – for example, distinguishing the musical note "do" from the verb "do".

But all things considered, DOTSYS III stands as a significant milestone in the progression of aids to the blind. Not only is it a major advance in Braille translation in its present form, but with modification of its program tables it can be used to process different kinds of text, such as text containing mathematical or technical notations, languages other than English or text containing non-standard symbols for format control. With even a casual look to the future it is not difficult to see DOTSYS programs which, with further upgrading, will translate such data as scientific information or advanced mathematics.

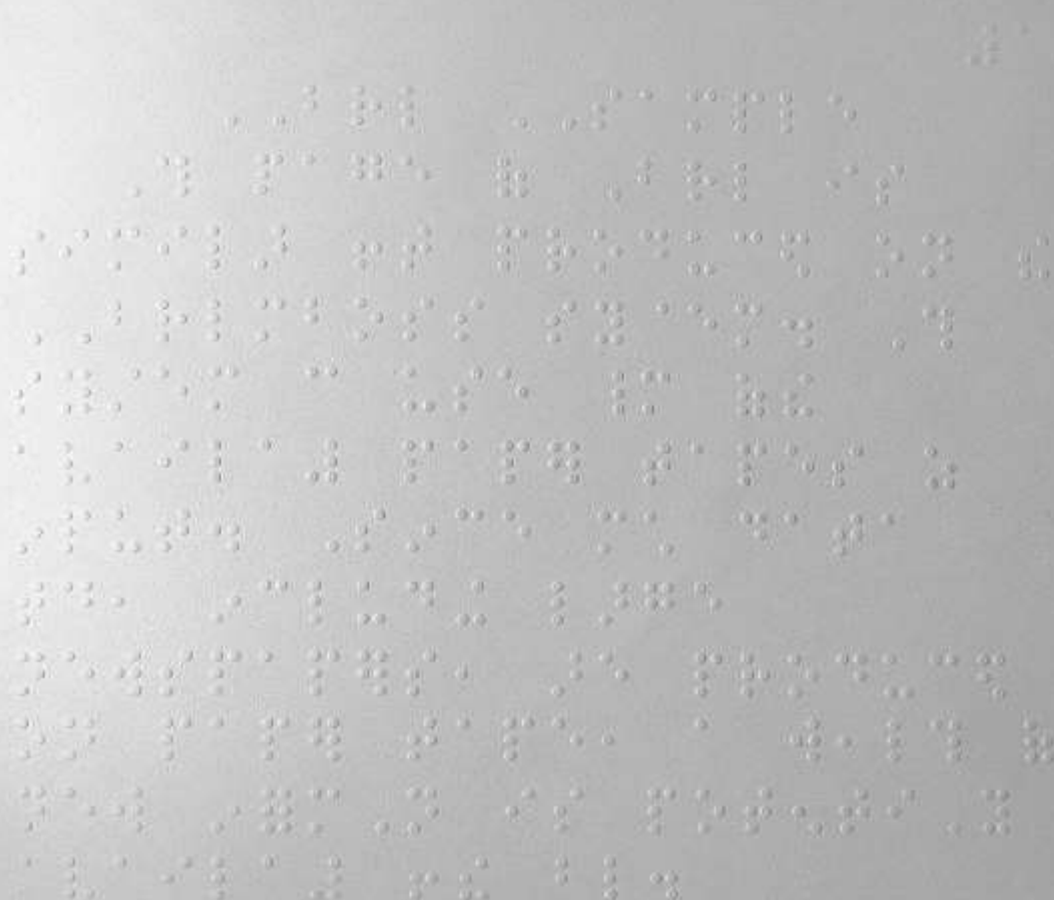
Even without further modifications DOTSYS III offers the blind

entry into a new world of learning, recreational reading and expanded careers. For example, a blind aerospace engineer in Cambridge, Massachusetts makes use of the Braille translation program to write, "debug", and read his own algebra programs.

At a public demonstration in January at the National Braille Press in Boston, "instant" Braille was demonstrated as being practical in a time-shared environment. An IBM 360 computer with the DOTSYS III program, MIT's new Braillemboss (developed for printing Braille text) and a teletype terminal for input, comprised the system for the demonstration.

In this operation, the text was keyed into the computer from a remote teletype, the computer then shut off the teletype, translated English to Braille, turned on the Braillemboss and printed out Braille. It then turned on the teletype for further inputs.

Actually many available paper tapes can be used as input. Considering the amount of data produced today on paper tape (most large newspapers are typeset by paper tape), there is a huge data base now potentially available to the blind. In short, the blind now have fingertip access to a whole new world of information, and just in time if they are to play a meaningful role in a society that is becoming more data-oriented every day.



Below is the printed version of the Braille sample above. Contrast the space required for each.

BRAILLE SAMPLE

This page of Braille is similar to that produced on the Braillemboss system. This system can use many of the available paper tapes as input. Since much data today, including large newspapers, are produced on paper tape, a wealth of new information is potentially available to the blind.