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The Development of Automatic Braille Translation in Germany in Recent Years

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For more than ten years computerised braille production has been done at the Computing Centre of the University of Munster using the program for the automatic braille translation developed at that time by W. Dost and H. Werner. The quality of this old program (on average making only one serious misprint per braille page) proved quite satisfactory for that time, and it seemed to be the first one, together with the DOTSYS-system, which performed computerised braille production. Since 1968 the most important application consisted of producing a braille edition of an extract of two German weeklies published by the printing house Gruner and Jahr. About 5000 copies per edition were and still are printed at the Verein zur Förderung der Blindenbildung in Hannover and distributed free of charge to the blind. This program has been taken over for use in other German-speaking communities; so it is used at the Stiftung Rehabilitation in Heidelberg for the production of books and educational material just as at the Bundesministerium für Unterricht und Kultus in Vienna for the production of primers (schoolbooks). The Deutsche Zentralbücherei für Blinde in Leipzig plans to use the program for the production in the German Democratic Republic as soon as the technical equipment is available.

The main difficulties for automatic braille translation of German texts arise from the fact that the German language allows forming compound words by concatenation of several words (eventually connected by a boundary morpheme). Using a system of rules conceptually similar to a finite state transducer to perform the translation, the above-mentioned program tries to read letter by letter from left to right and look ahead for a possible application of a table entry giving the translation for this part of the word. The reform of the German grade two braille which was under way for several years and decided upon in Vienna 1972, tried to accommodate automatic braille translation as much as this was compatible with the core of the classical rules. Representatives of our working groups participated in this discussion and could influence the formulation of the rules by bringing in our experience in braille translation. Nevertheless as before we had to live with one error per braille page.

The method sketched above had reached a certain limit but new ideas suggested by W.A. Slaby allow a far better quality of the translation. They consist in analysing the morphemes of German words by looking for their string context at the left and the right. To incorporate this idea into a MARKOV-algorithm for the translation it was necessary to analyse as many text corpora of the German language as were available to us in order to look for all possible exceptions during the translation process. The bulk of this work was performed by the German scholar Prof. Dr. Splett of the Institute for the German Language and his students in cooperation with the Computing Centre of the University of Münster within two years of research work. B. Eickenscheidt undertook the programming and implementation of the resulting program; in particular he carried out the tedious work of developing routines for formating the input and output of this and the program described below. The translation by means of the MARKOV-algorithm has an extremely simple structure; it uses a system of MARKOV rules which are ordered by priority to split a word into segments and translate one segment after the other. The work of J. Splett and his students led to a system that was manifested in approximately 7000 MARKOV rules.

Another realisation of the same basic idea was developed by W.A. Slaby. He also translates segments of the word considering the string context of it but staying with processing the word from left to right.

In enhancing the set of rules some precaution is necessary to avoid the falsification of a translation that had been previously correct, before the new rule was added to the system of translation rules. For this purpose he keeps a set of correct translations, and every change of the system of rules is first of all checked for its effect on the test words. If necessary, additional test words are inserted to keep at least the standard obtained previously. The generation of the rules for this program can be done interactively. It looks like a dynamically operating learning process with respect to stepwise improving the translation.

Both new translation programs have greatly improved the quality of the automatic braille translation such that the number of errors is now reduced to about one error per 50 braille pages. Hence these errors are negligible in comparison with the errors caused by incorrect input of the text.

At present there is only a small amount of hyphenation incorporated in our programs but we hope to include hyphenation to a greater extent, in the near future, such that better use is made of the scope of the braille pages to compress the material distributed to the blind.

The programs are written in PL/1 and are such that they easily lend themselves to an implementation on microprocessors. Thus we hope to have made it technically possible to distribute the programs to schools and other institutions for the blind in the near future.

Braille translation of the German language has thus come to a certain completion. Now improvement is due on the technical sector. Years ago we modified the paper-tape reader of our IBM computer such that it is possible to read compositors' tapes furnished to us by printing houses.

In Germany we are in the state of replacing the card- or paper-tape driven embossing machines by those controlled by ECMA cassettes as it is done at the Stiftung Rehabilitation in Heidelberg in cooperation with the Deutsche Blindenstudienanstalt in Marburg.

As a new contribution to the work for the blind in Germany we started a research project financed by the Ministry of Research and Technology. The project tries to synthesise speech output from the inkprint input. In spite of the experience gained with the analysis of texts in automatically producing braille, the problem seems considerably more difficult. The development is rather new but first results are promising though it is not yet possible to give a concluding judgement on its final outcome.

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Computerised Braille Music Production Using CIMBAL

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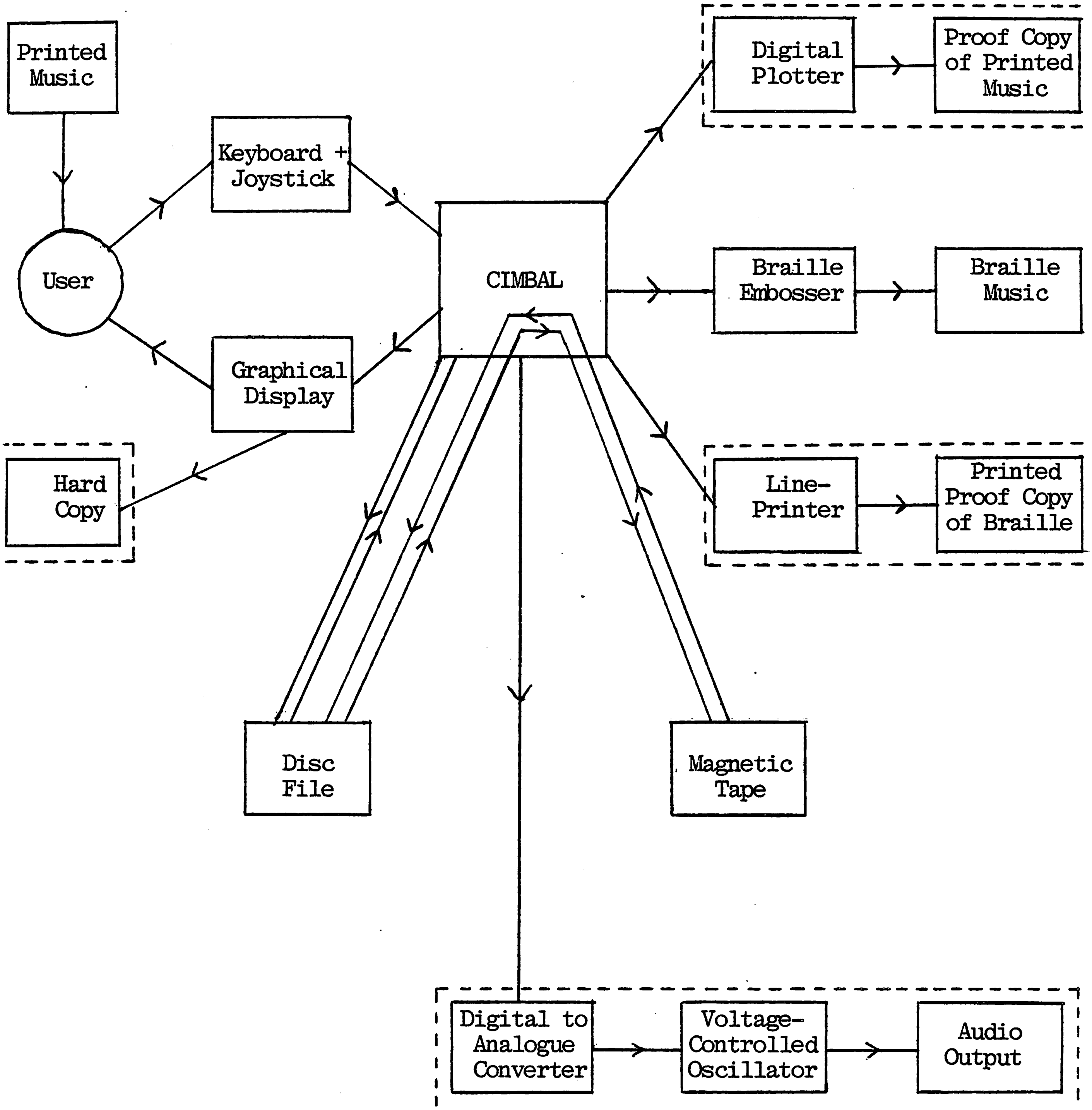
The purpose of the system is to enable a person with no braille knowledge to produce good quality braille music, thereby alleviating the shortage of highly skilled braille music transcribers. A major consideration in the design of the system was the need for easy transfer from a research environment to a production environment. It has therefore been developed as a software system using standard computer devices for the essential hardware components (see figure 1).

The prototype software has been implemented as a single computer program in order to simplify development and ensure compatibility between the different stages. For ease of reference, this program is named CIMBAL. CIMBAL could in principle be divided into a number of smaller programs to perform the independent functions of input of music, braille translation, formatting of braille, and archiving.

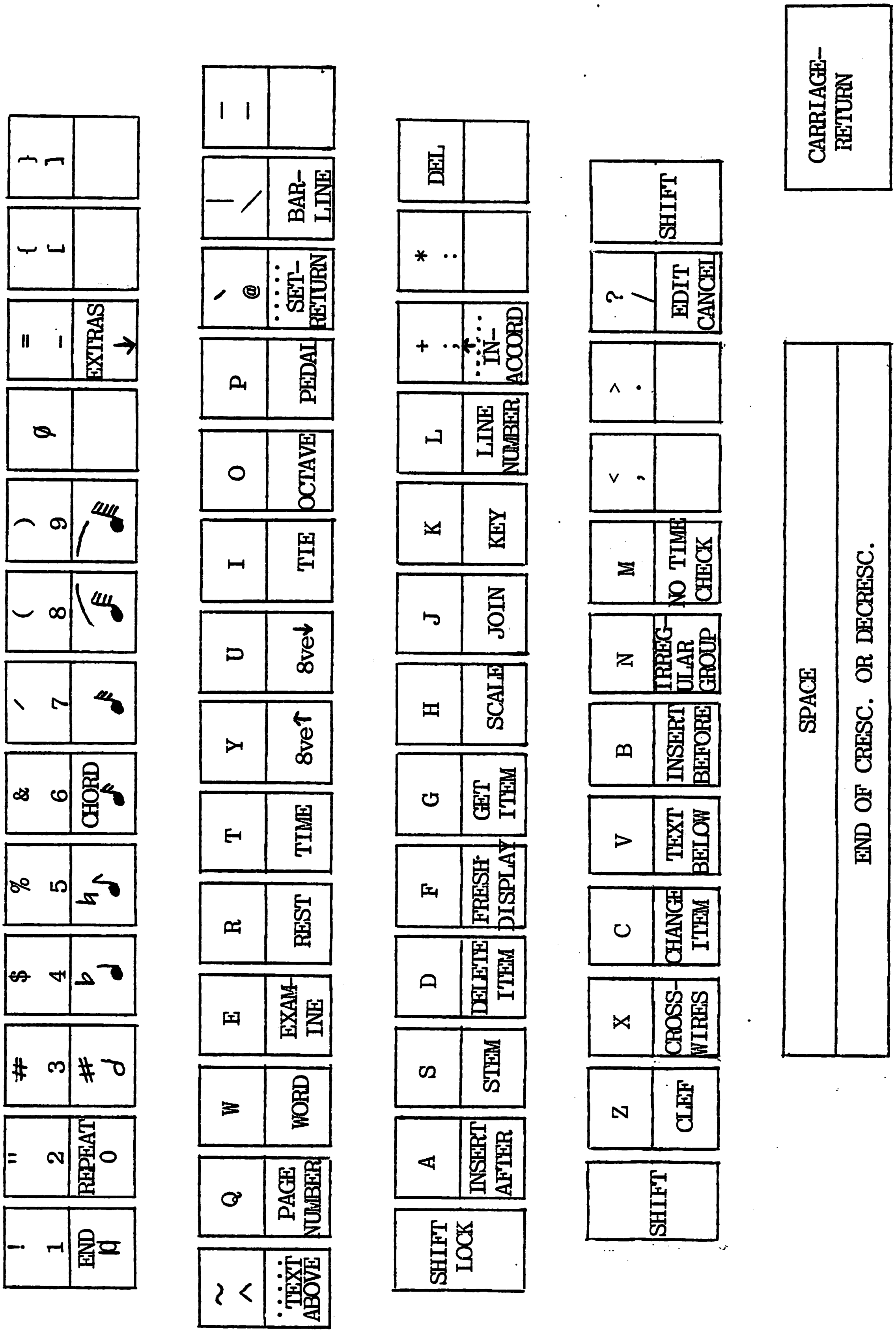
Use of the System

The conversion of sheet music to braille using this system may be summarised as follows. The user reads the printed music and types on the keyboard of a graphical display unit (GDU). In general, only the form and layout of the printed symbols are significant; the user need not be concerned with the musical interpretation of the symbols. The music is typed using a readily-learnt character code developed for the purpose. As far as possible, the code is mnemonic (see figure 2). For example, the pitch of notes is represented by the letters A to G. Additionally, some music symbols are marked on the front of the corresponding keys.



Boxes enclosed by broken lines are not essential components

Figure 1 System Hardware Block Diagram



The upper half of each box shows the standard symbols; the lower half shows additional meanings marked on the front of the keys.

Figure 2 Graphical Display Unit Keyboard Layout

As the music is typed, a visual representation similar to the printed page is displayed on the screen of the GDU. The user may easily detect any typing error by comparing this display with the original. The program itself will prevent some potential mistakes from occurring by, for example, checking that the total duration of notes in a measure is correct according to the time signature. The user has the option of correcting any mistakes either immediately or by subsequently recalling stored music for editing.

The music is stored as it is input, a measure at a time, into a disc file. This file contains a compact encoding of the printed musical and textual symbols, which is not, except in the case of text appearing on the printed page, directly related to the sequence of characters typed.

On completion of input, the stored music may be displayed for proof-reading. In the prototype system this may be done directly on the screen, on a digital plotter, or by taking hard-copies of music displayed on the screen. The last of these three methods is too expensive for regular use.

Errors noted by the user during input or proof-reading are subsequently corrected by editing on the GDU. The location of an error is identified in two stages. Firstly, a measure is selected by typing its bar and line numbers. The measure is displayed on the screen and the user then identifies the exact location within the measure by using a joystick to move a perpendicular pair of crosswires displayed on the screen until they intersect at the desired position. A function (insert, delete, change, etc.) is selected by typing a single character. Any new information is added using the input character code.

When the music is stored correctly to the user's satisfaction, a measure for measure braille equivalent may be produced by typing a single command. A further braille version, formatted according to the bar-over-bar layout may be produced using another single command.

Although the system is intended to avoid the use of a skilled braillist, the braille may be proof-read if desired, either on the screen of the GDU, or using simulated braille printed on a lineprinter, or by producing hard-copy braille on a braille terminal. Any errors in the braille may then be corrected by editing on the GDU, in the same way as for the print. This facility is useful for music of a type or complexity not translated completely correctly by CIMBAL, or for short-term avoidance of faults in the translation algorithm while they are traced and corrected.

When the braille is stored correctly to the user's satisfaction, a single command may be used to create a further file suitable for copying directly to an on-line braille embosser. In the prototype system, two models of embosser have been used for this purpose (Triformation LED 120 and SAGEM TEM 8BR).

A copy of the entire digitally encoded music, in both print and braille forms, may be stored on a long-term storage medium at this or any intermediate stage. In the prototype system, open reel magnetic tape is used for this purpose.

An addition to the prototype system enables a monophonic melody to be played audibly, using the digital to analogue output converter of the computer to drive a voltage-controlled oscillator.

Technical Information

In order to fulfill the requirement for portability, all software is written as far as possible in the most widely available programming language, USA standard FORTRAN X3.9-1966. However, the inherent unsuitability of FORTRAN for various essential functions, including manipulation of information in units of 8-bit bytes, has made it necessary to incorporate a few small routines written in Macro-symbol assembly language. The source program contains over 12,000 lines, including commentary. In the prototype implementation on a Rank Xerox Sigma 5 computer, CIMBAL requires a total of 115K bytes of storage. The program is overlaid to run in the available core space of 34K bytes, although ideally 50-60K bytes would be desirable.

The hierarchy of units for storage of the encoded music is shown in figure 3. The encoding of items, the smallest independent unit of information in this hierarchy, is outlined in figure 4. A single random-access disc file is used for storage of both print and braille forms of a piece of music. A file size of 60K bytes has been found adequate to hold a fairly substantial piece of music (500 bars of piano music) in its three forms.

The graphical display unit used in the prototype system is a Tektronix model T4002. This has 1024 x 760 addressable points on a screen measuring 6½ x 8¼ inches (16.5 x 21 cm).

The source program, together with documentation, can be supplied on digital magnetic tape to any bona fide braille research or production organisation wishing to investigate the possibility of using this system or developing it further. The format of the program tape is: 9 track, 800 bytes per inch, recording method NRZI, odd parity, unlabelled, EBCDIC code.

Evaluation

Preliminary evaluation using a group of musicians with no braille expertise suggests that the rate of input (including proof-reading and correction of the printed music) is, after some practice, around the equivalent of 20 braille lines per person-hour. This is faster than the typical transcription rate of manual transcribing staff, working in pairs. It is difficult to quote a rate per page of printed music, since the density of printed musical information may vary considerably.

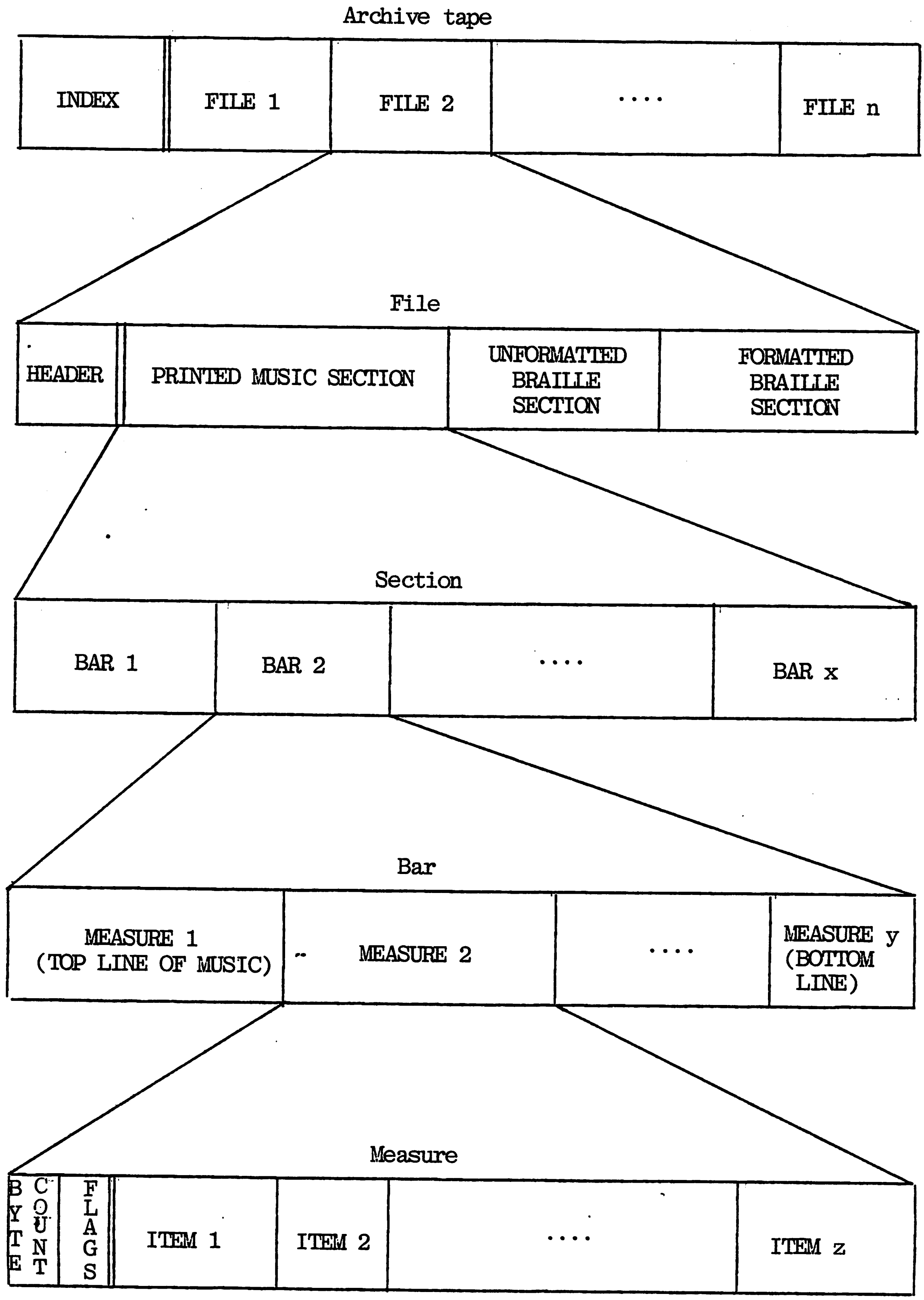


Figure 3 Hierarchy of Storage Units

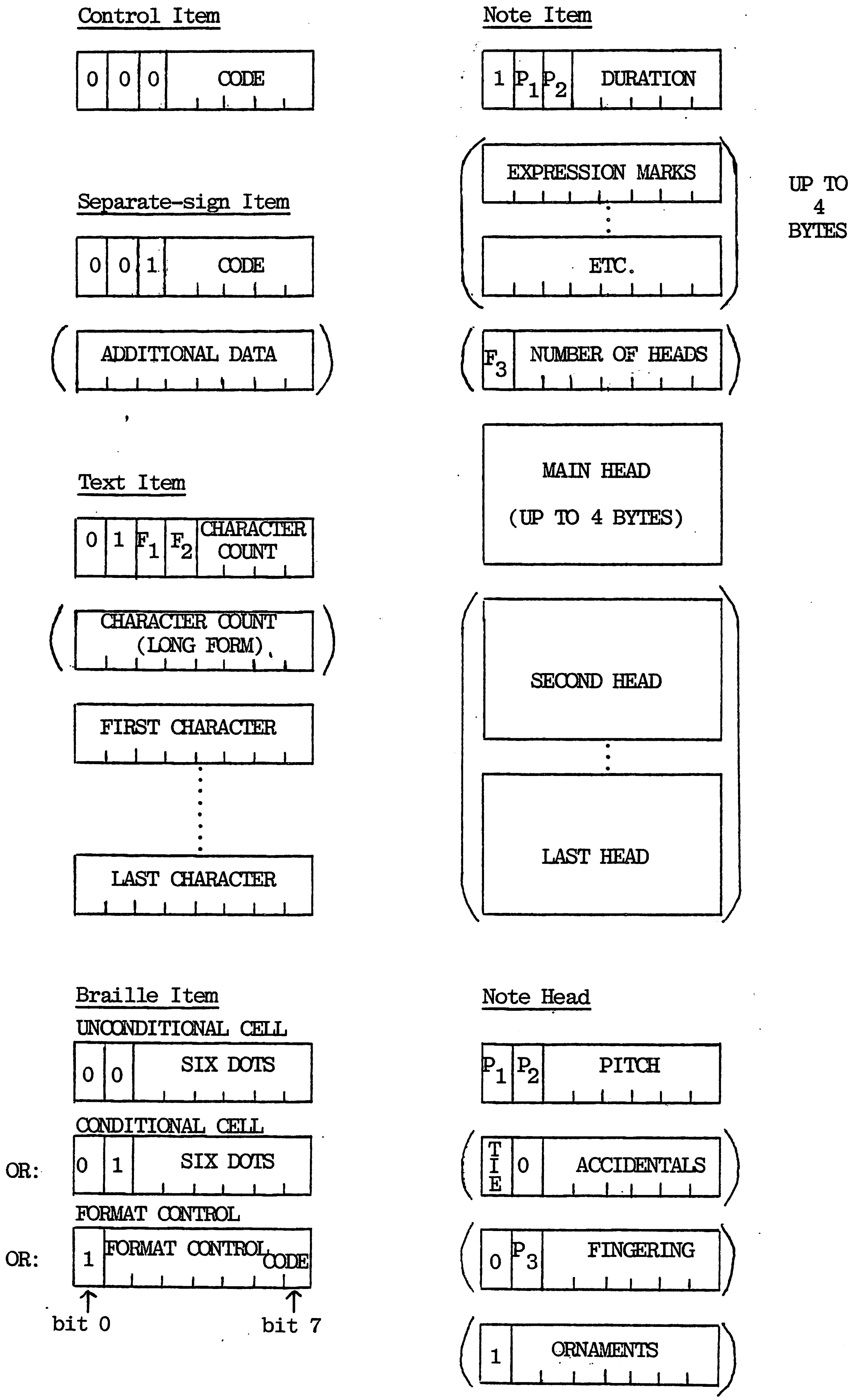


Figure 4 Coding of Items

The average speed of the translation process has not yet been accurately estimated. This is fairly slow, and depends to a great extent on the length and nature of a piece of music, largely because of the searching needed for the automatic detection of repeated passages. The time taken is, however, insignificant by comparison with that required for input.

An initial evaluation of the quality of the braille transcription has been carried out with the assistance of a number of braille music readers. This quality depends to a certain degree on the type of music. It is very high for solo instrumental music, for which pieces have been transcribed with no known errors. Simple keyboard music has been produced on a standard which satisfies expert braille music readers. More complex instrumental music leaves a few minor problems to be sorted out, several of these involving the layout of the braille. Vocal music is not at present laid out entirely satisfactorily, and further work is needed to remedy this. The majority of differences between the computer-produced braille music and its manually transcribed counterpart involve only details of layout, rather than affecting the information content.

Acknowledgements

This research project was financed by the Science Research Council and carried out between 1976 and 1978 at the University of Warwick. A full account of the project, including program documentation and all technical details, is given in Humphreys (1979a).

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New Production Systems in Braille Printing

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At the moment the production of braille books in West Germany is undergoing a process of rationalisation in the large braille printing houses. This rationalisation involves the setting up of new production systems. Various German companies with their equipment are playing a part in the creation of this presentation is to describe the individual units produced by the manufacturers and their interplay within the production chains.

Before the planning of the new production organisation, the printing of braille books was carefully analysed and examined in its principal stages. Allow me to describe this analysis as background information.

1. Analysis of Braille Printing

Braille printing can be divided into two categories according to the costliness of production:

(a) Literature in which special notation systems are used (e.g. mathematical, chemical, musical notation) as they occur in textbooks.

(b) Literature consisting only of continuous texts (e.g. literary works, periodicals).

A further factor in braille printing is the widely differing size of editions, which can range from several thousand to editions of fewer than ten copies for textbooks.

This paper was presented at the Braille Conference in London in May 1979.

Independent of the type of literature and the size of the edition, the production of braille material falls into four principal stages:

(a) Preparation of text
(b) Composition of text
(c) Correction of text
(d) Reproduction of text

1.1 Preparation of Text

The blind person must be presented with the same information content as is available to the sighted person in a normal printed book. For this reason the black printed book must be revised before it is transcribed into braille. This revision is extremely costly, especially in the case of textbooks (e.g. describing of pictures, graphs, etc.). It should be carried out by a specialist. With newspaper articles and literary works the preparation of the text can be performed by an experienced braille transcriber.

1.2 Composition of Text

This is the stage where the prepared texts are written. Under the old production system of braille printing the texts were typed in grade 2 braille on a braille keyboard by a braille transcriber and impressed into metal on an embossing machine. With single editions the composition is done by means of the page brailler on paper. Today the texts can be set up either in black print or in braille on a recording medium (e.g. compact cassettes or paper tape). Texts composed in black print must be transcribed into grade 2 braille by the computer before the next stage.

1.3 Correction of Text

Errors arising from the transcription of the texts into braille shorthand by the transcriber or from the computer program are in this stage corrected. Previously these errors have had to be painstakingly removed on the metal matrix. If however the braille is stored on a recording medium, it is possible to correct the errors that arise directly and without difficulty on the recording medium.

1.4 Reproduction of Text

In the text reproduction stage the composed and corrected texts are transformed in such a way as to enable the blind person to read them. The corrected recording medium can be used to run various pieces of equipment, and the following possibilities for production are offered:

1.4.1 Metal matrices are produced on an embossing machine and used to run off a large number of copies.

1.4.2 For small runs the page brailler can be used to produce copies from the recording medium.

1.4.3 The recording medium can be read direct by means of reading instruments with tactile lines (e.g. Braillex, Braillocord).

In the last case appropriate converters are needed to transform the recorded data since the reading instruments use different physical recordings than that used in braille printing.

2. New Production Systems

The stages of braille printing listed above can with the new production systems be executed rationally for the widest variety of braille literature. The two extremes of braille printing, namely the textbook with special notation systems on the one hand and printing without special notation systems on the other, led logically to the creation of two production systems for braille printing. As however there is neither a textbook without long passages of continuous prose nor a literary work without special characters, these two production systems are fully compatible. Compatability of the two production systems is ensured by a standardised recording medium. Figure 1 shows the production organisation for braille printing based on the University of Munster's programme.

The two production systems are identical apart from the composition stage. Whereas all continuous texts without special notation can be composed in black print and transcribed automatically into braille, all texts with special notation shall be composed in braille. The organisation illustrated above allows however for a book to be composed partly in black print and partly in braille. In this case text correction is extended to include merging and editing the two recording media.

3. Equipment for the Principal Production Stages

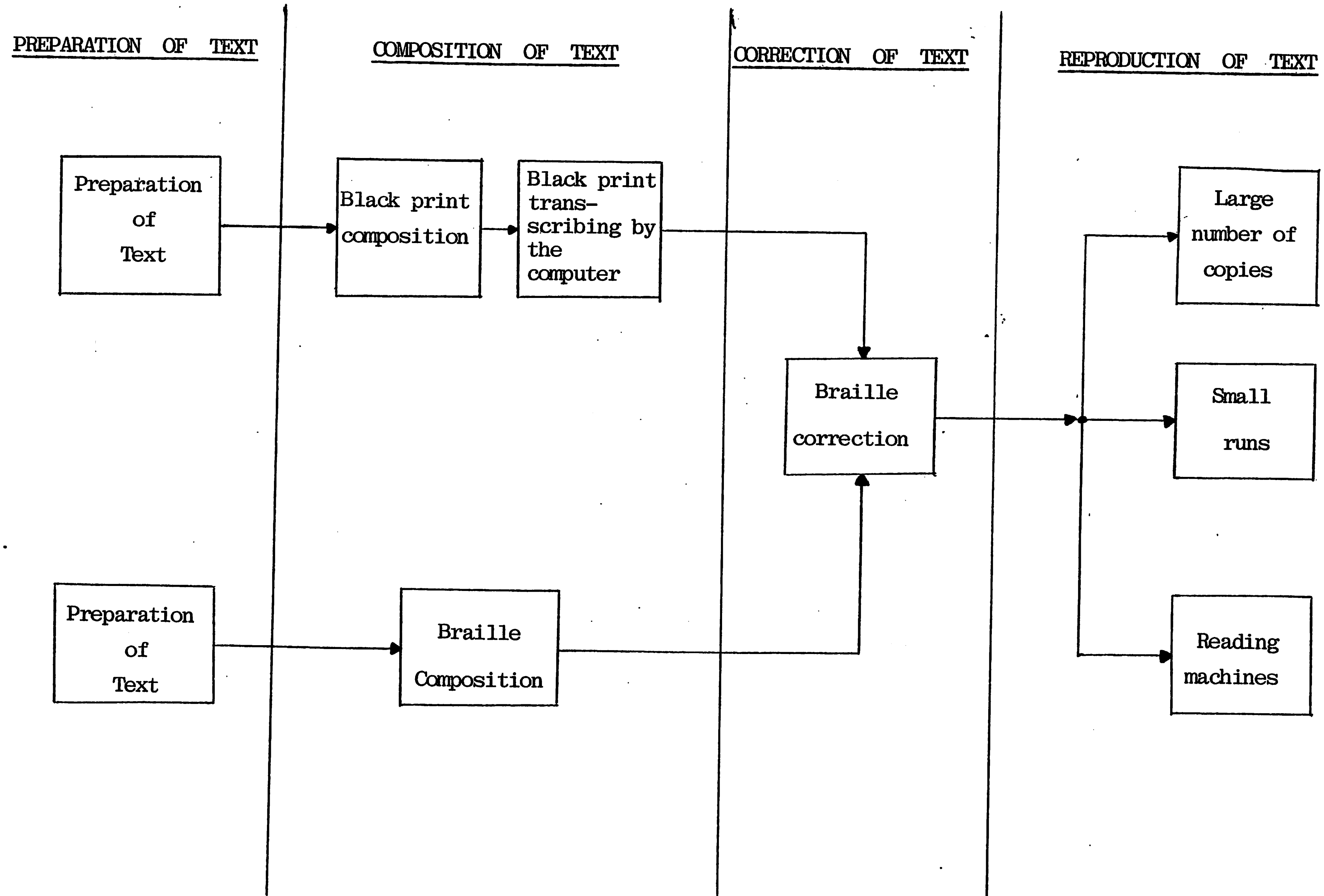
3.1 Preparation of Text

This stage, as mentioned above, requires the experience of the specialist teacher or braille transcriber. This means that this stage will never be automated. It will continue to be an important cost factor in braille book production.

3.2 Composition of Text

As already mentioned, composition can be done in one of two ways:

(i) black print composition
(ii) braille composition


PREPARATION OF TEXT
COMPOSITION OF TEXT
CORRECTION OF TEXT
REPRODUCTION OF TEXT
Preparation of Text
Black print composition
Black print trans-scribing by the computer
Braille correction
Large number of copies
Small runs
Reading machines
Preparation of Text
Braille Composition

3.1.1 Black Print Composition

Black print can be composed efficiently by means of conventional text editing machines. It is important here that the machines deliver recording media that can be read by the computer. The translation of the black print into braille shorthand will then be performed in the computer.

The most efficient method of black print composition applied in West Germany up to now has involved the use of publishers' recording tapes. Today this method has already become standard in braille book production in many countries of the world. As well as the advantage that the black print is already composed on a data carrier, the use of publishers' tapes for braille printing in West Germany has revealed the following:

- There are great organisational difficulties involved in getting hold of compositors' tapes.
- The stored texts are as a rule not free of errors.
- The type of recording medium (paper tape, half-inch magnetic tape, compact cassettes, quarter-inch magnetic tapes) varies with the different composition systems.
- The recording codes are not uniform in the composition systems used.
- With some publishers special codes are also often arranged for each book to be printed.
- For the editing of compositors' tapes a versatile text editing system is indispensable.
- Extra material created at the time of preparation of the text has to be incorporated into the main text on the terminal.

In West Germany however, the trend is away from the use of publishers' tapes and towards an even more rationalised method. AEG-Telefunken are at present developing a character recognition machine which used a television camera to detect black print which it recognises electronically. With this instrument the above-mentioned problems arising from the use of publishers' tapes can be avoided. The character recognition machine can read the most important types of print and transfer them to a recording medium. Within the production system the recording medium is read by the computer, which translates the black print into braille shorthand.

3.1.2 Braille Composition

Braille composition is this system carried out with the aid of a data handling unit for braille developed by the STIFTUNG REHABILITATION, Heidelberg. This unit, which comes in versions for sighted as well as for blind operators, delivers a recording medium (ECMA 34 cassettes) on which the braille is stored. In addition to a light-action ergonomically designed keyboard, the unit offers correction facility within a line of braille (maximum line length 40 characters). As an alternative to the ECMA 34 cassettes, 8-position paper tape can also be used as the recording medium.

3.3 Correction of Text

The Federal Ministry of Research and Technology made funds available for a high-performance correction unit for braille, which has been developed at the STIFTUNG REHABILITATION, Heidelberg.

Here are some important technical data:

(a) Microprocessor-controlled central unit

(b) Storage of one page of braille with maximum 40 lines of 40 characters per line.

(c) Within the page of braille every conceivable correction facility is offered.

(d) The unit is equipped with a visual and a tactile display.

3.4 Reproduction of Text

With the standardised recording medium used throughout the system, machines for high-volume braille page production as well as machines built for small runs can be operated.

Large Editions

For large runs of braille books it is first necessary to produce a metal matrix. For this purpose a high-speed embossing machine of the German Blind Studies Institute, Marburg, is used, which embosses ten braille characters in one second (Puma 4). If large runs (over one thousand copies) are required, these are produced with the embossed metal matrix on the Marburg Blind Studies Institute's rotary press. This applies particularly in the case of periodicals. Alternatively the metal plate can be fitted to a flat bed press. This process is used particularly when high-quality printing is required, as is the case for textbooks.

Small Runs

Specialist literature is often only produced in small editions. In this case it is better to avoid the long and costly way via the embossing machine. In the production methods described here books are embossed in small runs on the (Darmstadt) Thiel-Company braille printer. This machine can also be controlled by ECMA 34 compact cassettes. It has a possible line length of 40 characters and embosses 3 lines per second.

Text reproduction is also possible outside the realm of printing. Braille recorders are available to the blind for this purpose. It is necessary thereby to convert the tape used in braille printing. In West Germany there are at the present time two instruments available:

(a) The Braillocord, made by AID Electronic, Berlin
(b) The Braillex, made by Papenmeier, Schwerte

With all two instruments it is possible to read braille books line by line, the braille characters being brought up a line at a time on an electromechancially controlled tactile display. None of the two instruments was designed purely for the reading of braille books. All 2 instruments have a multitude of additional functions, the discussion of which would be outside the scope of this presentation. We draw your attention to the detailed desscription of the individual instruments contained in the information files, and also to the exhibition, in which all models are on display. We would however like to say very briefly:

- The Braillocord is a versatile reading and writing instrument for braille.

- The Braillex makes possible the independent creation and reproduction of ordered files of data, e.g. dictionaries; it could be described as an electronic private secretary.

Summary

On the last diagram you can once again follow the production chain and at the same time recognise the individual units in their positions within the chain.

Microprocessor Braille Translator

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1. Introduction

The aim of the project was to develop a compact inexpensive system for the production of contracted braille. The specification included:

(i) the operator must not be required to know braille

(ii) the system must be easy to use

(iii) the braille must be a good approximation to Grade 2 Standard English Braille

(iv) the system must require the minimum of maintenance

(v) the system must be suitable for producing from 1 to 20 braille copies embossed on paper.

2. System Description

The basic system is:

(i) input of the text on a conventional keyboard by a typist with no knowledge of braille.

(ii) proof-reading and editing of typing errors on the visual display unit.

(iii) translation of the text to a good approximation to Grade 2 braille.

(iv) output of the braille on an on-line embosser.

The basic configuration is shown in Figure 1.

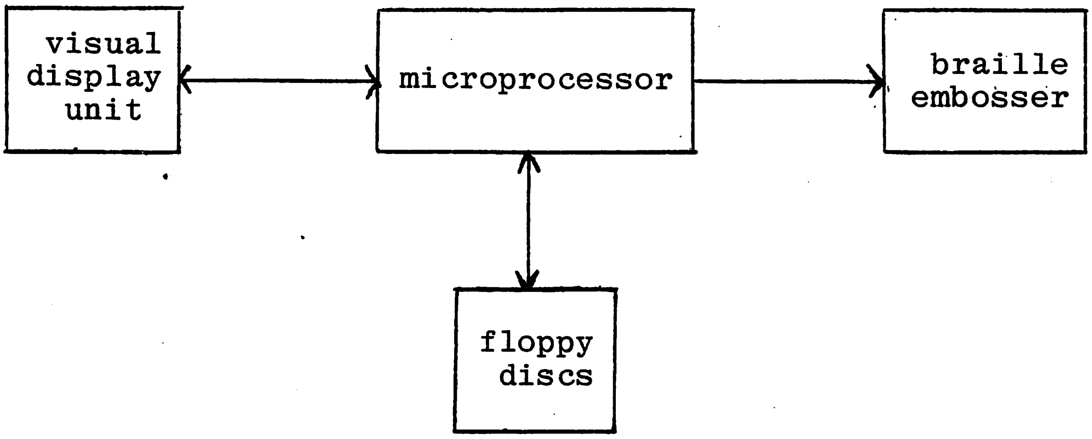

Figure 1 Basic system configuration

3. Program Specification

This section solely refers to the program to translate the text to contracted braille. The main features of the program are:

(i) produces a good approximation to Grade 2 English braille.

(ii) able to run on a M6800 microprocessor with 32k bytes.

(iii) written in a language which is as easy as possible to implement on other microprocessors. A simple version of Fortran IV met this criterion.

(iv) machine transferability is more important than optimal use of storage.

(v) requires minimal training of the input typist.

4. Program Description

The translation program is controlled by a contraction table which is of the form:

columns	1-9	text string
column	10	previous character type
column	11	current character type
column	12	number of input characters
column	13	number of output characters
columns	14-18	output string

character types are:	L	letter
	S	space or punctuation
	N	number

Examples

ALLY LL424Y

The text string ALLY is translated to 4Y only when ALLY is preceded by a letter.

AS$ SS32Z

The text string AS followed by a space or a punctuation sign, and preceded by a space or punctuation sign is translated to Z followed by a space or punctuation sign.

$ represents one of: space . , : ; " - ! ? / ( )

The entries in the translation table are grouped by the same initial character. The program checks the first character of a string and then compares serially the text strings in the relevant part of the table. Therefore the order of the entries in the table can affect the translation.

The table has 363 entries but could be expanded to give a better approximation to Grade 2 braille. The choice of table entries was determined by an analysis of 2½ million words text which had been produced in braille.

The program has limited format commands. In the present version, two spaces at the beginning of a line results in a new paragraph in the braille output. A blank line in the text input results in a blank line in the braille output. Otherwise all multiple spaces automatically result in a single space in the output.

The program will not hyphenate a word across the end of one line and the beginning of the next. Page numbering is handled automatically. A contraction can be suppressed since the program will not contract across ↑ but the symbol will not appear in the braille output.

The program could use less memory if a subroutine were written in a low level language to handle the individual bytes. This has not been done with this version since it would make it harder to transfer the program to another microprocessor.

5. Conclusion

This program could form the basis for a small braille production system suitable for the fast transcription of documents.

Computerised Braille Production in Australia

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Summary

The Royal NSW Institute for Deaf and Blind Children operates Australia's only computerised braille production system. The installation is located at St. Leonards, a suburb of Sydney. Hardware includes a Data General Eclipse mini-computer and two Triformation Systems LED-120 embossers. The software was purchased from Duxbury Systems Inc. The system has been operational since May 1978.

Australia has some unique characteristics, some of which present problems in the area of blind welfare generally, and provision of braille, more specifically. The total population, and the population of blind persons, is relatively small, and is widely dispersed. Each state has one or more agencies providing welfare services to the blind, and one or more braille libraries. Co-ordination of services, especially braille production and libraries, on a national basis has not been achieved. To date, no national union catalogue of braille materials has been compiled.

Initially the relative lack of financial support from federal or state governments to braille producers was a problem, but, the public purse-strings have now been loosened.

In addition to computerised braille production, there are several centres throughout the country using manual production techniques. Most of the personnel involved are volunteers. This results in inefficient, but inexpensive braille production, and potential customers often baulk at the prices asked for the computerised transcription service.

This paper was presented at the Computerised Braille Conference in May 1979.

It has taken several months to gain patronage of the transcription service. However, sales are now being made to welfare agencies, braille libraries, and some private persons and to the NSW Education Department.

The Institute

The Royal New South Wales Institute for Deaf and Blind Children is the oldest children's welfare organisation in Australia, founded in Colonial Sydney in 1860. The Institute provides schooling and accommodation for five different categories of children - deaf, blind, educable deaf-blind, trainable deaf-blind and multihandicapped blind. A range of services is provided including medical, dental, and psychological care, vocational training and career education, parent counselling, library services and braille transcription services.

Children from throughout NSW and the Australian Capital Territory attend the Institute's Deaf and Blind Children's Centre, which includes modern schooling and residential facilities on 16 hectares of land. The NSW Department of Education is responsible for the provision of teachers at the school for deaf children, and the school for blind children, which includes the educable deaf-blind. The staff at the deaf-blind trainable school and the multi-handicapped blind children's special school/nursing home are employed by the Institute.

The Institute is governed by a Board of Directors presided over by Sir Garfield Barwick, who is the Chief Justice of Australia. Annual recurrent costs amount to almost A$2,200,000 (about £1,250,000), of which about half is met by government subsidy. Subsidies for major items of capital expenditure can be as high as 80% of total cost.

The Installation

The Institute operates Australia's only computerised braille production system. The installation was established in May 1978. The initial configuration of the Data General Eclipse C330 mini-computer included 96K bytes of main memory, 10 megabytes of disk, a tape drive, a 60 character per second printer terminal, two visual display units, and two Line Embossing Devices, (LED-120's), the last supplied by Triformation Systems Inc. of Stuart, Florida. At the time of writing we had ordered and were awaiting delivery of a further 32K bytes of main memory and a 50 megabyte disk unit to replace the current 10 megabyte unit. (This upgrade was completed with minimal disruption to operations towards the end of March this year.)

The application software was purchased from Duxbury Systems Inc. of Stow, Massachusetts. Others to use the Duxbury software are the Canadian National Institute for the Blind, Toronto, and the Clovernook Printing House for the Blind, Cincinnati, Ohio.

Description of the Production System

The transcription process consists of three parts:

(i) the entry of text;

(ii) the translation of text into Grade I or Grade II braille;

(iii) the embossing of the translated text.

Text entry is performed by operators typing the text at the two visual display units. Text entry is controlled by the Duxbury Text Editor program[1], which has numerous advantages over the various Data General text editor programs available. The editor is a re-entrant subroutine, permitting editing to take place simultaneously at the two terminals. It is "line-oriented"[2] and operates directly upon a direct-access disk file. The operator is able to add, insert, and delete lines by reference to line numbers. It is also possible to locate text by searching, without knowledge of the corresponding line number. Alterations can be made on specific lines, groups of lines, or throughout the text. For example, the command '15 TO 20 REPLACE TOM BY HARRY' would alter lines 15 to 20 in such a way that wherever the three-character sequence "TOM" used to appear, "HARRY" will appear instead.

The editor also provides a facility for creating a sequential file from the direct-access file. This sequential file is used by programs other than the editor itself. A direct-access file can also be reconstituted from the sequential file. Once a file has become stable, the direct access file is deleted and set up again only temporarily for editing as necessary.

The second stage, translation, is performed by the Duxbury braille translator. This program, written in Fortran IV, is an outgrowth of two earlier programs DOTSYS II and DOTSYS III developed in the early 1970's at the MIT Research Establishment. The translator reads the sequential disk file produced by the editor (or produced by another program, such as a compositor's tape convertor). The input text is in the form of variable-length lines (records) of ink print text images. The output, another disk file, is the sequence of braille signs equivalent to the input text.

The translator's author, Joseph Sullivan, describes it as being almost completely table-driven, i.e., details of the translation algorithm are determined by tables read in at execution time rather than by the program itself.[3] Tables exist for several languages, and there are different table for 'American' English braille and 'standard' English braille. On the Data General Eclipse as configured at the Institute, the rate of translation is 1500 words per minute. Translation errors do occasionally occur. These can be corrected either by the insertion of special "editor's symbols" in the original text, or by updating the table, an action which will prevent recurrence of the error. The translator expects to receive text just as it appeared in the original ink print, with a few exceptions. For example, single quotes should have been typed as double quotes, even though a quotation may be included in another. A dash in ink print should have been typed as two hyphens.

Additionally, the translator recognises certain insertions in the text (editor's symbols) which are used to perform particular functions, either the special representation of certain punctuation and print conventions in braille, or the formatting of the braille pages. Examples of the former include capitalisation, italics, accent marks, and the correct sequencing of combinations of parentheses, brackets and italics. Examples of formatting include new paragraphs, new lines, the skipping of one or more lines, skipping to a new page from other than the last line, tabulation (e.g. for columnar information), hanging indentation and centred headings. The translator automatically prevents the splitting of words at the end of lines, and looks after paging and page numbering.

Other functions which can be controlled through editor's symbols include switching between Grade I and Grade II braille, the inclusion of ink print page number in the braille for cross-referencing and the automatic inclusion of a title on every page. As mentioned previously, situations may arise that cause problems with the automatic translation of braille, usually deriving from the sound or meaning of the text. To overcome these, symbols may be included which will either enforce or prevent the contraction of nominated letter-groups as required.

For the most part, the insertion of editor's symbols is performed by the data entry operators as part of the data entry process. In some cases, where layout of the braille is less straightforward (e.g., braille calendars), the text is subjected to a pre-input step which involves hand-writing the required editor's symbols onto the source text before data entry.

The third stage of processing is embossing. The translated text can be transferred directly from disk to a Line Embossing Device (LED-120) or can be printed out as ink print braille. At the Institute we use the former option and the embossed braille is then proof-read.

Proof-reading is performed by a blind reader, reading aloud from the braille and a sighted reader checking what is read against the original source of the text. The braille reader also uncovers spelling, contraction, and layout errors. Required corrections are indicated on the computer-printed text listing, which is returned to the text entry operator.

Corrections are made via the VDU's and the text is re-translated. The final corrected version is then stored on magnetic tape, from which braille copies can be produced as required.

Each of the two LED-120's can produce 2,000 pages of braille in an 8-hour working day. The paper used is continuous sprocket-holed fanfold stationery weighing 148 grams per square metre.

The computer services staff trims, separates, punches, and binds the brailled sheets into volumes of about 60 pages. The embossing programme is flexible with regard to page length and spacing between lines of braille.

Transcriptions

In the ten months, July 1978 to April 1979, 61 titles, made up of 276 volumes, were transcribed and are held in the magnetic tape library from which braille copies are produced for sale. These publications include, novels, plays and anthologies of poems or short stories. Almost half of the works were written by Australian writers. About half were written specifically for children or adolescents. Almost all appear on the NSW Education Department's high school syllabus in the subject of English, history or economics.

Additional transcriptions, totalling 32 original volumes, have been made on request for various agencies and associations of the blind. These include magazines, newsletters, agendas and minutes of meetings, information pamphlets, calendars, football fixture lists, tape recorder operating instructions and so on.

Australia

Australia has some unique characteristics, some of which present problems in the field of blind welfare generally, and in the provision of braille, more specifically. The total population, and the population of blind persons, is relatively small, highly urbanised, but widely dispersed because Australia's cities are so far apart. The nation has an estimated 750 braille readers.[4]

Each of Australia's six states has several agencies providing welfare services to the blind. Only a few organisations operate in more than one state. Each state has one or more braille libraries. Co-ordination of services, especially braille production and libraries, on a national basis has not been achieved. Only recently has the National Library of Australia given an undertaking to compile a national union catalogue of braille and other special media materials.

Braille is acquired either through purchase from the Royal National Institute for the Blind or the American Printing House for the Blind or by production in Australia. About twelve centres of braille production are in use, all but one of these using manual production techniques. Most braillists are unpaid volunteers.

The situation in Australia with regard to library services for the visually handicapped has been described as fragmentary and inadequate.[5] Special problems have been recognised; the almost complete lack of serial and foreign language braille and the shortage of current, topical, and varied reading matter found in periodicals. However, in Australia there is a growing awareness of the needs of the handicapped generally[6] and the visually handicapped specifically. There is a widespread desire to improve and expand services. The installation of the computer to produce braille is one initiative which illustrates that progress is being made.

The Biggest Problem - Money

Computer-produced braille is expensive. In its report of November 1978, the Libraries Sub-Committee of the Australian National Council of and for the Blind stated "...(the computer) system is now fully operational producing braille of a high standard. However, because of the high cost...its effectiveness is limited, (and) many organisations still rely on manual transcription using voluntary labour."[7] The National Federation of Blind Citizens, in a submission to the Working Party on Library Services to the Handicapped, stated as a principle that "...the braille reader should be able to buy books of his choice...at a price no greater than the printed copy."[8] In the same submission they say "Its difficult to see how braille production ought to be funded, to say who should bear the ultimate responsibility for cost. However, funds should surely be available through a joint response from the Federal and State Governments with appropriate contributions from agencies for the blind."[9] Unfortunately, the required joint contribution from Governments has not been forthcoming.

However, there is a bright note. The NSW Education Department has for some years operated a braille transcription service employing paid transcribers and proofreaders. This service aims at meeting the braille requirements of children at the Blind School at North Rocks in Sydney, and of blind children who attend integrated high schools under the 'mainstreaming' programme. The Education Department has recently decided to supplement their service by commissioning transcriptions from the Royal Institute's computer service. It is probable that the Department will allocate A$50,000 (about £26,000) annually for this purpose.

The role of the National Library of Australia in providing special media reading matter has been widely discussed. Those in Australia concerned with talking book or braille production or with library services for the blind, look with admiration and some envy at the work done by the Library of Congress in Washington. At a National Library of Australia Consultative Seminar on Library Services for the Handicapped, convened in Canberra in August, 1978, a documented recommendation stated that "The need (exists) to direct substantial resources into the production of materials. In this regard the National Library should commission works."[10] The Director General of the National Library, Dr. George Chandler agreed. In the National Library's report on services for handicapped people[11] he stated "The right to read is shared by all, and ways must be found to satisfy the reading needs of handicapped Australians." Unfortunately, faced with the need to provide numerous new services at a time when staff numbers have been reduced and budgets pared, the National Library has not been able to involve itself in this way.

The cost of Australia's computer braille installation including the recent upgrade was A$150,000 (about £80,000). This was met entirely by the Royal NSW Institute for Deaf and Blind Children. Annual operating costs amount to about A$70,000 (about £40,000). This cost is made up mostly of the salaries of the six members of staff, paper costs, and equipment maintenance charges. The only source of government grant is through the Federal Government's book bounty, paid through the Department of Business and Consumer Affairs. The book bounty was introduced by Act of Parliament in 1969 to encourage the Australian publishing and printing industries by means of a subsidy. The bounty pays one-third of the total cost of production of eligible publications. Most braille books are eligible under the Act. After bounty, annual costs (in £ Sterling) are about £27,000. At our anticipated level of production of 24,000 original braille pages per annum the unsubsidised cost per page is equal to about £1.13. How should this cost be met? The imposition of a transcription charge by the Institute to cover this cost has resulted in rather limited patronage of the transcription service.

The cost of copies presents a less gloomy picture. The cost of materials for a sixty-leaf volume, including mailing container, is about £1.23. The Institute charges about £4.00 a volume for copies, and a number of braille libraries and some private persons have availed themselves of this source of braille.

Because of the Institute's heavy financial commitments in areas of child care, the budget for braille production is limited. Where, however, we have lowered the charge for "special" jobs, patronage has been good. We produce a quarterly magazine for the National Federation of Blind Citizens in 100 copies at £2.000 per copy. Another magazine, on the subject of cricket, sold 50 copies at £1.70. I imagine that it will take some time for potential customers, who are accustomed to using volunteer transcription services, to accept that the costs of efficiently, promptly and accurately produced braille is high. I am keen to hear the experience of the managers of other computerised braille systems.

Copyright

I intend not to dwell on the question of obtaining copyright permissions, primarily because the procedure is likely to change with the passing of new Federal legislation. Briefly, until now permissions have been negotiated directly with copyright holders or their agents, not through any clearing house. This is a time-consuming process but is usually successful in acquiring permission without fee. The new legislation may result in the need to pay for permissions but through a much streamlined procedure.

Miscellaneous Problems

Hardware and software maintenance have created some problems in our three-supplier configuration. The mini-computer, manufactured and maintained by Data General, has performed well. We lose only about three hour's production time per month.

Maintenance of the LED-120 embossers initially gave us problems, which we thought had been overcome. Unfortunately, with the heavy increase in usage following the recent large orders from the NSW Education Department, new maintenance problems have arisen. In spite of daily attention, embossing quality has dropped. A new problem has arisen, that of the embossing pins piercing the paper. The has apparently occurred because the embossing die has been roughened from the heavy usage. At the time of my departure from Sydney three weeks ago, advice was being sought from Triformation. Unfortunately time-zone differences add to communication problems; in Florida business hours are 11 p.m. to 7 a.m. Sydney time. Triformation Systems are not represented in Australia and the maintenance is carried out, under contract by Honeywell Pty. Ltd.

The LED's require remedial maintenance, some preventive maintenance, and adjustment of the embossing pins. Down-time is as high as 50 hours per month.

I am particularly keen on learning from other installation managers about maintenance problems - and more importantly the solutions that have been arrived at.

Some software maintenance has been required, as can be expected with any software. My policy has been to have Duxbury Systems carry out that maintenace. Joe Sullivan knows his programs much better than I know them. Unfortunately the separation of 20,000 kilometres between Joe and me has caused some difficulty with communication. Maintenance by mail is slow and prone to some level of error, and we have suffered some loss of productivity as we seek ways to overcome translation errors. I wish, however, to emphasise that the Duxbury translation package is an excellent product in the main, and the "bugs" we have uncovered occur only in obscure, and infrequently arising circumstances.

As previously mentioned, the translation program relies largely on a table look-up process. Over time and with the experience gained by Duxbury users, a rather complete and accurate table has been built up following American Braille rules. In Australia, however, English braille is the standard, and we have met the need to fairly extensively modify the tables. More than 5% of table entries have been added or changed. We now have a fairly complete table. It appears though, that English braille rules are less consistent than the American rules and we will always be required to force or prevent some contractions by using editor's symbols in the input text.

Plans

The Royal Institute hopes to make use of the research developments of braille producers to provide both new services and better production techniques. Should a demand for such services be indicated in Australia, we would seek to provide:

(i) Braille mathematical texts
(ii) Braille music
(iii) Braille bank statements

To improve production we are interested in developments which bypass the input keying process, such as the use of compositor's tapes and optical scanners such as the Kurzweil Data Entry machine.

Conclusion

Some of the problems faced at the Royal Institute with the production of braille are technical. The installed system and our operational procedures satisfactorily produce braille of good physical quality with few errors. We have some hardware maintenance difficulties.

Our problems in Australia have related to the difficulty of finding the braille readers and in having them state their requirements.

Funding has been a major problem, with most potential users of the transcription service being deterred by the need to meet transcription costs. Copies of our braille books do go into several libraries, with some persons buying books for private ownership. The specific assistance of Government Departments and Government-funded institutions was at first conspicuously lacking, but we now have a public patron, the NSW Department of Education.

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2. ibid

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4. Wilson J.W. (1977) Letter from Honorary Secretary, Australian National Council of and for the Blind, to Mr. D.W. Croisdale, Chairman, WCWB Sub- Committee on Computerised Braille Production.

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6. ibid

7. Australian National Council of and for the Blind (1978) *Report of the Libraries Sub-Committee.*

8. National Federation of Blind Citizens (1978) *Library Services for the Visually Impaired Print Handicapped Citizen.*

9. ibid

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11. National Library of Australia (1978) Op. cit.

Dialogue With a Computer

B. Causse[2], G. Gouarderes[2], M. Truquet[1]

[1]TOBIA - Transcription par Ordinateur en Braille Intégral et Abrégé

[2]CERFIA - Cybernétique des Entreprises Reconnaissances des Formes Intelligence Artificielle

We feel that the oral dialogue with the computer can assist the blind with a great facility.

From the following systems:

- TOBIE system (braille translation), realised at TOBIA's Centre (L.S.I.[3] Laboratory)
- ARIAL[4] project for speech recognition (CERFIA Laboratory, Director: G. Perennou),

available today, a common project was being issued.

The general purpose of this new system is to supply the blind with alternate combined input/output, to access information through a computer.

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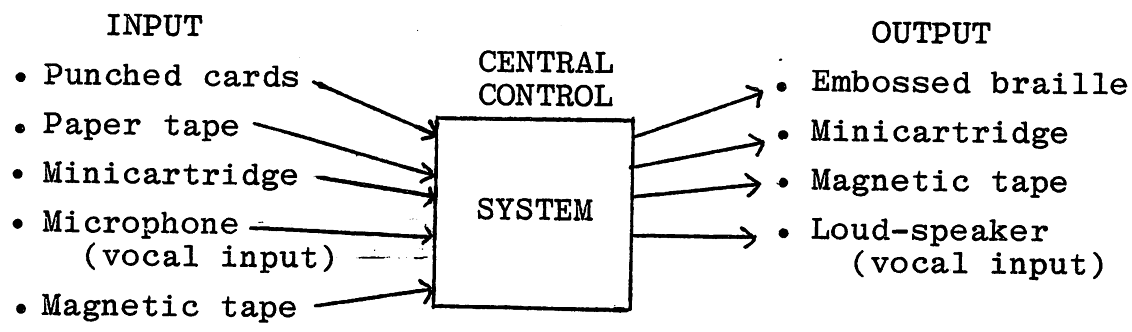
[3]L.S.I. - Language et Systèmes Informatiques

[4]ARIAL - Analyse et Reconnaissance de l'Information Acoustique et Linguistique

Principal components



Each corresponding terminal device can be used with the others.

The project is subdivided in specific oriented tasks; two of them have been studied. Their present state of the art will be described as follows:

(a) Both production of embossed braille and phonetic string from ink print texts.

We use an automatic interactive lexicon system for spoken French; its basic lexicon increases interactively according to a given application (about 6,000 entries, today, corresponding to 37,000 flexed forms). Each word is represented with different level attributes: acoustic, phonological, phonetic, synthetic, semantic and braille form.

For unknown word (i.e. not in the lexicon or mis-spelt) we translate it into braille by TOBIA system and into phonetic by an orthoepic translator. Another consultation of the lexicon with the new phonetic key allows to disclose the spelling mistakes and to proprose a correction.

The given 4 - uplet: graphic, phonetic, braille, morpho-syntactic indicator is used by the braille editor and the pronunciation model:

Example:

```
** EXECUTION **

ENTREZ VOTRE PHRASE ECRITE?
?AU MOYEN AGE,LES HOMMES PREFERENT LES OISEAUX. @

## SUITE DES MOTS PHONETIQUES-SORTIE DU MODELE GRAPHEMES.PHONEMES:

O MWA*59 XAJE L6Z XQM PR6F7RET L6Z XWAZO

## PHRASE PHONETIQUE-SORTIE DU MODULE DES PAUSES:

OMWA*7NAJE L6ZQMPR6F7REL6ZWAZO

## PHRASE PHONETIQUE FINALE-SORTIE DU MODULE DES ELISIONS:

(OMWAJSNA   LCZ MPREF 7RLEZWAZO) CODE A.P.I.

OMWA*7NAJE L6ZQMPR6F7RL6ZWAZO ------------> to the VOCODER

## SORTIE DU MODULE BRAILLE:

K  MOY?- ICE & HMS !/F/R2 & ]SEKX ------------> to the SAGEM DEVICE

** FIN EXECUTION **
```

It must be noted that all talking computer terminals presently available are rather tiresome for an intensive listening.

At the CERFIA Laboratory, a staff directed by G. Perennou has obtained primary results with a new designed experimental speech synthesisor.

(b) Speech input - braille text output.

According to the present topics in speech recognition we consider three modes for incoming data through a vocal computer input: isolated words, dictating and speaking. We have selected dictating for 5 reasons:

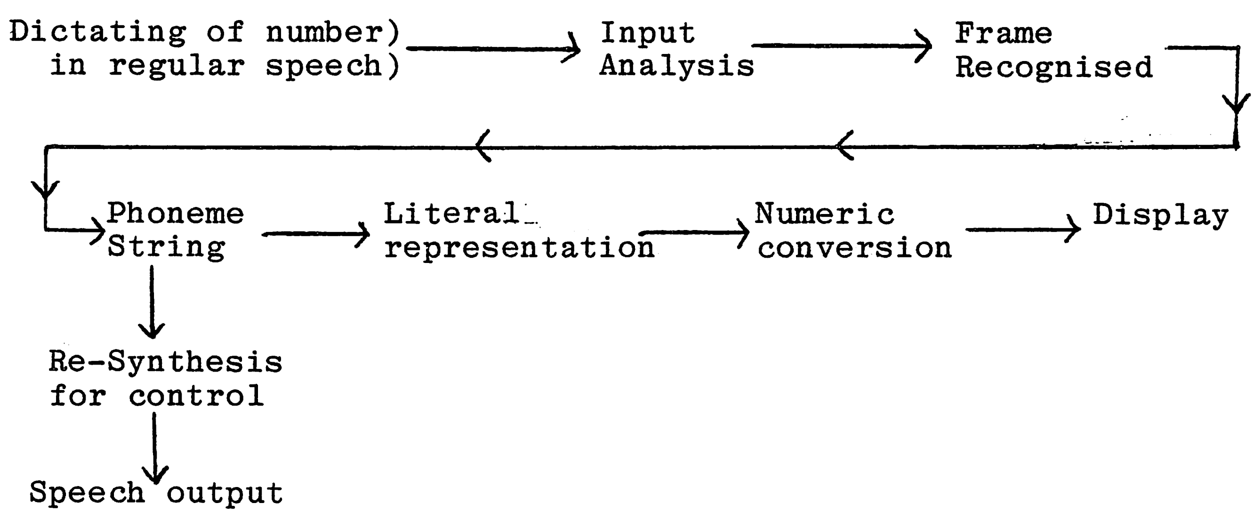
(1) It is a rather regular method in business and management and it needs no practice for novice dictators;

(2) The only "typing" and "editing" instructions are dictated in conventional words;

(3) No "a priori" vocabulary limits: the automatic lexicon system increases immediately by an interacting dialogue with the user;

(4) All recognition processes in acoustic, phonetic, lexical and pragmatic levels are acting in real-time as in isolated words method;

(5) The last reason, is that we have obtained complete results in number recognition with the following scheme:



Remarks
about the braille production at TOBIA''s Centre

Two years ago, TOBIA's Centre was created. Since this day, more than 40 thousand braille pages have been produced (with one typist, one braille Sagem device):

- School books, novels, special documents, exam subjects, bank statements...

This Centre is open to anybody wanting braille documents, therefore the needs exceed the means we have, a project of a new Centre; a sort of a Public Centre is being studied.

The observations we can make, after these two years, are:

(1) To code a text is not a real problem for the typist (although they have about ten codes to learn). 8 days are sufficient to type easily.

(2) The real problem is:

- to not forget a phrase, a word;

- to not replace a word by another word, for example: OBLIGATAIRE instead of OBLIGATOIRE, CLAUSE instead of CAUSE

so we are obliged to read the typescript conscientiously at the same time as the original text.

The difficulties are found at that level, and the aid brought by a vocal input seems to be one solution.

A Double-Sided Braille Embosser

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Summary

The embosser is developed at SINTEF and the prototype is used in braille production at Tambartun School. The prototype embosser is producing one sheet of paper, or two pages of text, in 20 secs. The production model will at least work at double speed, i.e. one sheet in 10 secs. The embosser must be used in conjunction with a text-processing system.

1. A Brief History

The first thoughts on the embosser emerged during a seminar on braille printing in 1969. At that time, SINTEF had been engaged in the development of computerbased type-setting systems. Such systems seemed to be very suitable for braille production also and a system, including the present embosser, was outlined. One of the problems, at that time, was that the Norwegian grade II braille was very complicated to translate by a computer. The rules were, however, to be revised and further work was postponed while waiting for this revision. The plans were then more or less forgotten.

In the autumn of 1976, SINTEF was contacted by Tambartun School, a centre of education for the visually impaired. This school has the responsibility for producing the necessary textbooks for blind children at elementary school level.

This paper was presented at the Computerised Braille Production Conference in May 1979.

According to a new Norwegian law, handicapped children should - if at all possible - be allowed to attend ordinary schools. As these "integrated" pupils needed to have the same textbooks available to them as the other children had, this new law resulted in a sudden increase in the demand for new textbooks in braille, a demand that far exceeded the capacity of Tambartun. They planned, therefore, to install a computer-based, text-processing system, but they were in need of an output embosser able to emboss on both sides of the paper. So, we went back to work. The embosser was designed and built, originally as a test model. It appeared to work surprisingly well and, after some necessary modifications, ordinary book production at Tambartun started at the beginning of 1978. The embosser worked flawlessly for some months but then a problem in one part of the mechanism started occurring with increasing frequency. This part of the mechanism was, therefore, modified and since then the embosser has worked excellently.

From the time it began work until the writing of this paper, the embosser has produced approximately 14000 sheets of paper or 28000 pages of text. It is no longer the embossing that is causing the bottleneck at Tambartun.

2. The Output Embosser

The basic principle of the embosser is shown schematically in figure 1. The paper is fed stepwise between two oscillating beams. The two beams have a row of embossing pins arranged as shown in figure 2 as full drawn circles. The pin spacing is equal to the point spacing in one horizontal row of points, e.g. all points 1 and 4 of all the characters in one line. The embossing pins in the upper beam match recesses in the lower beam and vice versa. The recesses are shown as dotted circles in figure 2. The embossing pins in the two beams are positioned relative to each other so that the correct interpoint positions are secured.

The printing cycle goes as follows: when the paper stops in the correct position to have one row of points on each side embossed, the two beams will close on the paper and hold it firmly. The appropriate embossing pins are then actuated to emboss the points. When the embossing pins are withdrawn from the paper, the two beams open to allow the paper to be transported forward to the next row to be embossed. Three cycles are thus necessary to emboss one complete line on each side of the paper, or 80 characters, assuming a line length of 40 characters.

The embossing pins are actuated through levers mounted on bearings in the beams, as shown in figure 3. The beams are divided into two main parts: the lever part, where the levers are mounted, and the pressure part, which is the part that presses upon the paper during the embossing phase of the cycle.

The beams are driven up and down by means of an eccenter mechanism. The pressure part is springloaded to a position about 2 mm in front of the lever part and, as the beams are closing on the paper, the pressure part of the two beams will meet and hold the paper firmly while the lever parts will move a further 4 mm closer to each other. It is in this part of the cycle that the embossing takes place.

The actuating levers are mounted such that one end is directly above the embossing pins, while the other end protrudes from the beam, as shown in figure 3. If the protruding end of the lever is free to move up and down, nothing happens and no point will be embossed. If, however, the downward movement is restricted, the lever will push the embossing pin into the paper and emboss a point. The downward movement of the lever can be restricted by a locking pin, also shown in figure 3. This locking pin is actuated by a magnet, and as the force needed to move the locking pin is very moderate, it is possible to use relatively small actuating magnets. Nevertheless, in order to get enough room for the magnets, every second lever is brought out on each side of the beam and every second magnet is placed above and below the locking pins. In this way, we have 12 mm available for each magnet.

The force on the locking pin is carried by a pre-stressed spring, so that when the embossing force exceeds approximately 20 N, (2 kg), the spring will start to bend and limit the maximum force.

The paper used is manufactured by a Swedish paper mill especially for braille embossing. Other paper qualities may certainly be used but they have not been tested. In the prototype embosser, the paper has the same dimensions as one of the standards used for paper in computer peripheral printers, as shown in figure 4. The paper is fed by a sprocket belt driven by a stepping motor. Each step represents approximately 0.5 mm, (more exactly: 0.496 mm). The distance between points within a character is 2.5 mm, i.e. 5 steps. The distance between lines may be chosen at will to the nearest 0.496 mm. 21 steps will, for instance, give a line spacing of 10.4 mm = 410".

The paper-feed motor and the printing magnets are controlled from a dedicated microprocessor. This processor receives signals from the paper-feed mechanism in order to synchronise to the top of each page. It also receives a signal from the embossing beams' eccenter drive, and this is used to syncronise the printing magnet drive to the printing cycle.

The processor also takes care of the communication to the text-processing computer. Text is transferred two pages at a time from the text-processing system to a text-buffer in the embosser microprocessor memory. The microprocessor converts the ASCII characters to braille, and disassembles this to the rows of points to be embossed. As the two pages are embossed, the next two pages are simultaneously read into the microprocessor.

The prototype embosser at Tambartun operates at a speed of 10 cycles/sec, but it has worked up to 20 cycles/sec during a test run. In the prototype printer at Tambartun the beams are not divided in the two parts described above. Because of this it is only possible to emboss one side at a time. The paper is therefore kept stationary for two cycles in order to emboss both sides. The embossing time for one page (29 lines) is thus approximately 20 sec. on this prototype embosser. Conservatively, we estimate the production model also to operate at 10 cycles/sec. This means one sheet, or two pages of text in approximately 10 secs, allowing for some extra time for page shifting. The maximum line length will be 42 characters but, assuming a line length of 40 characters, (80 characters on both sides), the minimum embossing speed will be 266 characters/sec. With some experience, we hope to increase this speed to at least 500 ch/sec.

The embosser will be manufactured by the Norwegian firm "Egil Railo Verktøyindustri". At the time of writing, the firm is working to finance this production and hope to be ready to start production in April 1979.

3. The Text Production System

As the embosser prints on both sides simultaneously, it is necessary to have ready one full page and at least the first line on the next page, before the printout starts. It is, therefore, necessary to use the embosser in conjunction with a text-processing system. There is a multitude of such systems available on the market and the embosser may be interfaced to any of these.

In the Tambartun system, a rather advanced text-processing system, from the Norwegian firm "Norsk Data", is used. The main part of this is an unmodified text-processing system as used in newspaper and printing offices. Added to this standard system are some special features:

- automatic translation according to the unambiguous parts of the braille rules,

- presentation of "visual braille" on the screen, or at the output printer,

- communication with the embosser.

The production of a book is divided into three main steps:

- text input
- text processing
- printout and binding

Input text may come from one of the computer terminal keyboards, or through paper tape. Paper tape may again be punched on a freestanding punch with ordinary or braille keyboard. More interesting, however, is the possibility to get a computer-readable copy (e.g. paper tape copy) of the text used in production of the ink print book from a printing office. In this case, the text is loaded into the text processing system without any need to rewrite it. Other input methods may, of course, be used, as, for instance, OCR or magnetic tape but this is not yet used in the Tambartun system.

In the text processing phase, the text is converted to a form suitable for printout in braille. Some of the text must be rewritten, e.g., text referring to pictures, and some must be modified to braille rules as, for instance, the addition of symbols for capital letters. The unambiguous parts of this conversion are done automatically in the computer and the manual parts are done interactively on one of the computer terminals. At this stage, a proof copy is made either in ink print or in braille on the embosser. Errors found by the proof reader are again corrected interactively at the terminals and the corrected text is stored in the computer memory, ready to be embossed.

The book may now be embossed in the required numbers. One complete book at a time is printed out, on z-fold paper. The book comes from the embosser as a stack of papers with feed holes in both edges. One edge is glued together with the cover, while the other three sides of the stack are cut clean. The feed holes are thus kept in the back of the book where they act as a kind of hinge to facilitate reading of the book.

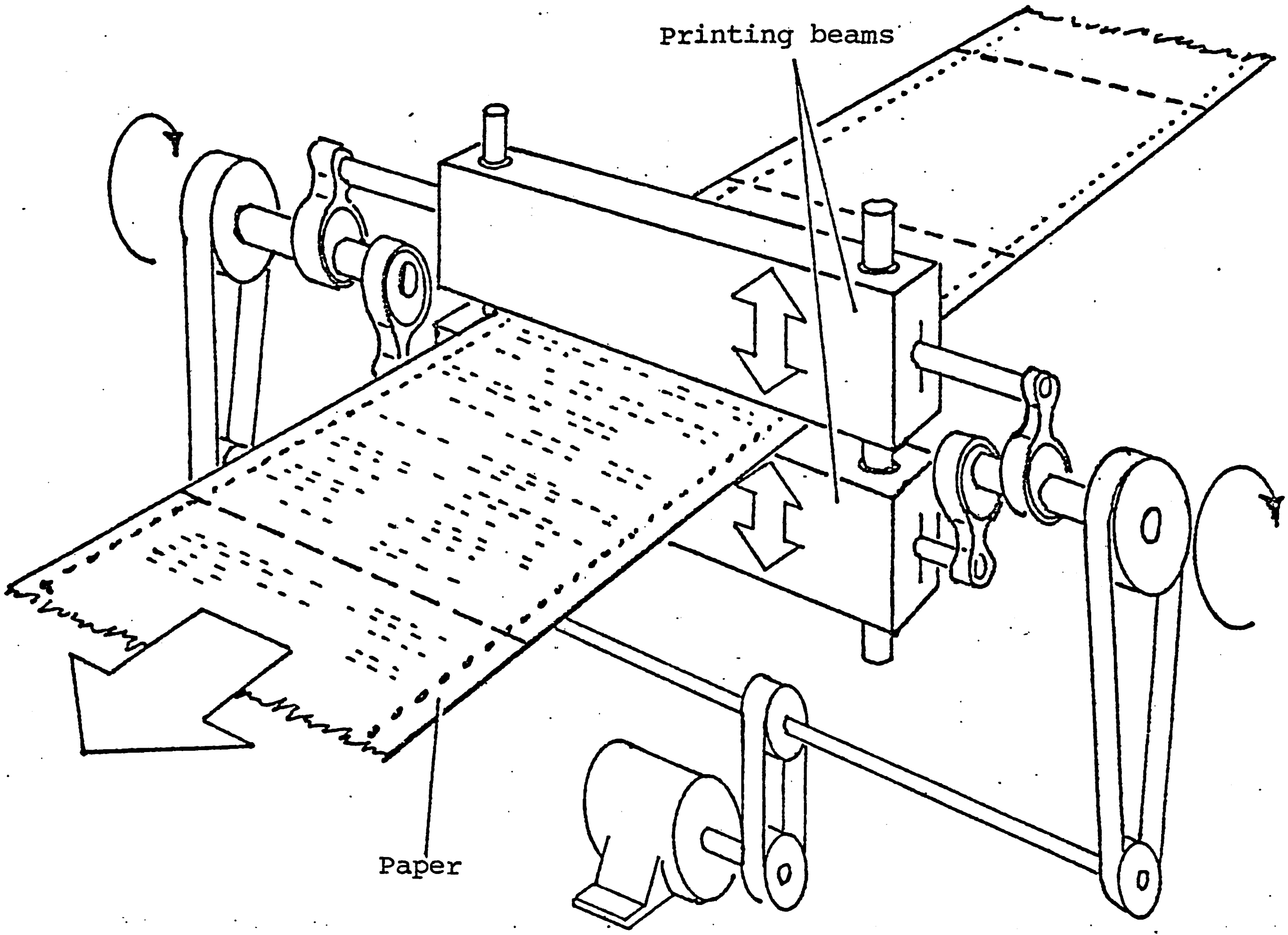

Fig. 1. Principle of the embosser.

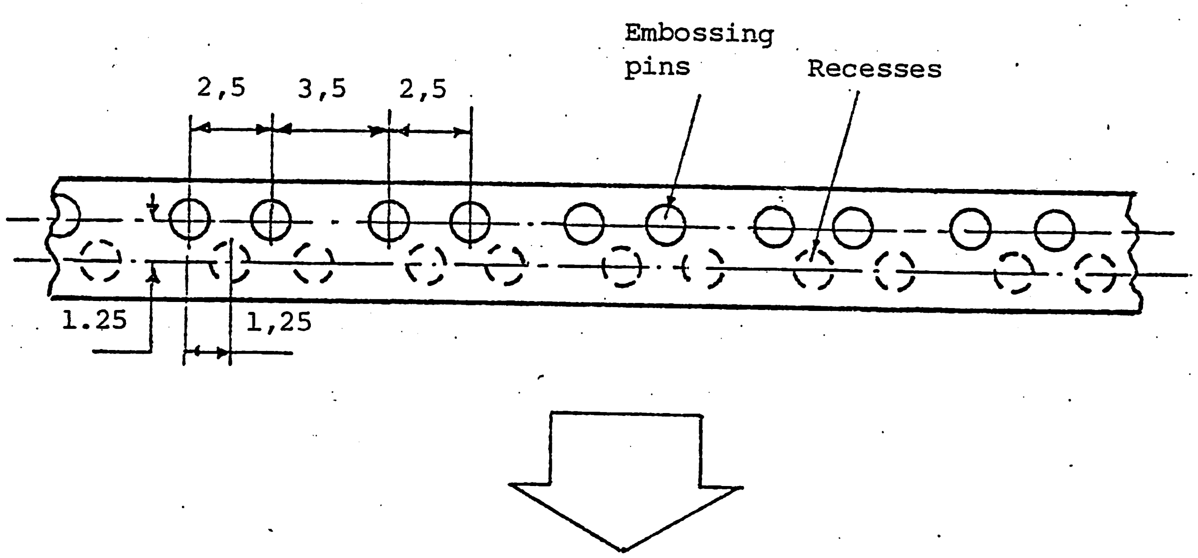

Fig. 2. Embossing pins.

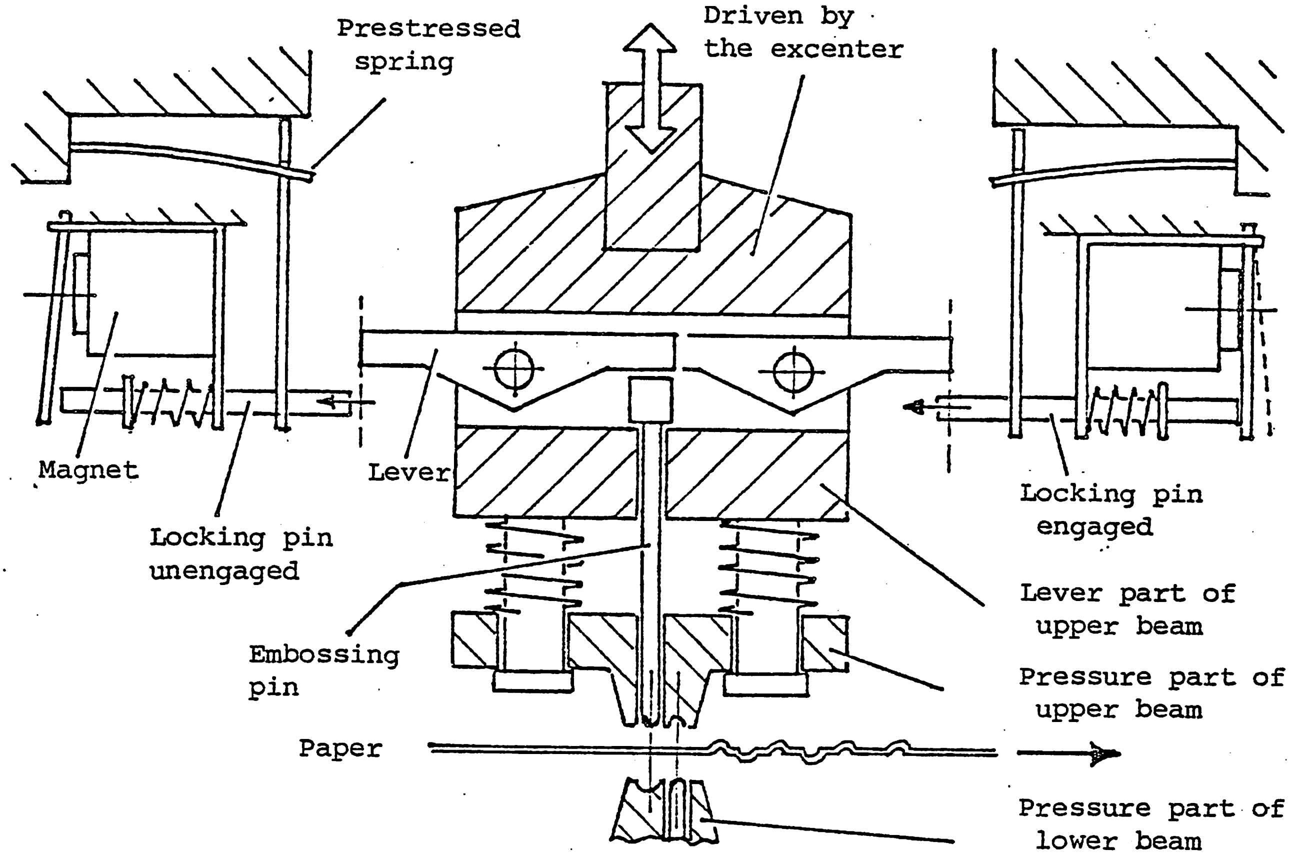

Fig. 3. The embossing mechanism.

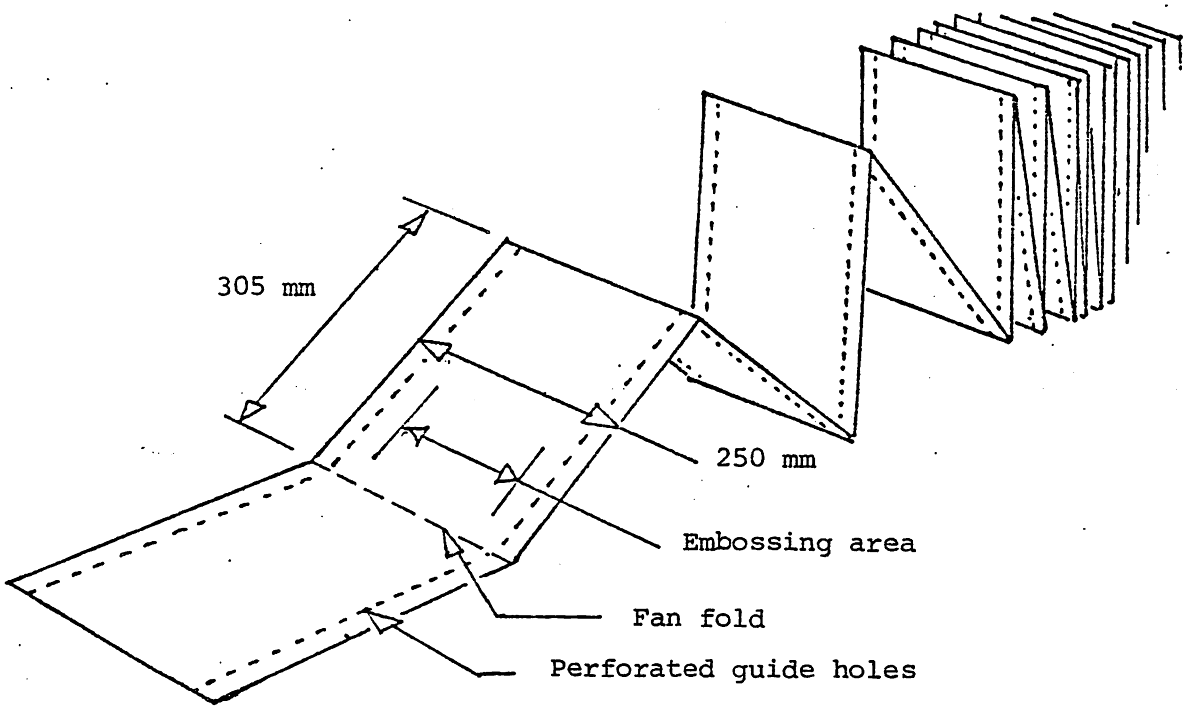

Fig. 4. Paper dimensions.

Interpointing of the LED-120

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The Triformation Systems LED-120 is an interactive, braille-embossing terminal. It is used by many solely as an output device. When used only for its relatively high-speed embossing capability, interpointing of pages becomes a very desirable feature. Interpointing is the embossing of both sides of a page without hindrance to the legibility of either side.

Here follow the details of a simple method developed at N.B.P. of producing interpointed braille on the LED-120.

Principle: Interpointing is achieved by embossing all odd-numbered pages first, offsetting the machine vertically and then embossing the even-numbered pages on the other side of the continuous-form of odd-numbered pages.

Formatting of the Input: This is by far the most costly step involved for those who are already producing braille on the LED. Rather than embossing the pages sequentially, they must be separated into two parts - odd and even. This calls for a change in programs and a change in storage procedure.

Tractor Positioning: The sprocket-hole tractors should be positioned so that dot 1 is 1-5/16" in from the left edge of the paper (including the sprocket-holed strip). The object of this positioning is to have dot 1 of side 1 just to the right (looking at side 1) of dot 80 of side 2.

Length of "Line Adv": The service/maintenance manual should be consulted to find how this one-shot is adjusted. Ours happens to be set at .7062". This is probably not the most efficient setting, but is sufficient for this purpose.

Registering the Embossing Unit: This step may be unnecessary. The entire interpointing procedure should be completed to determine the need for this adjustment.

Since minor shifting is more easily performed on the embossing unit than the tractor bars, the position of these bars is assumed constant here. The object of this adjustment is to equalise the distances 1) between dot 1 and the top of the page and 2) between dot 80 and the top of the page. In other words, to make the embossing die parallel with the top of the paper.

The tolerance necessary to shift the embossing unit may be obtained by "slotting" the holes for the screws that secure the front of the unit to the chassis. This should be performed only by a competent machinist. The force of the embossing is considerable and the unit must be firmly secured to the chassis.

Procedure for Set/Offset/Set: In describing this procedure, the following are assumed:

30-line setting
29 actual lines of braille maximum
dot 7-8 switch is off

The following margins should result from this procedure (assuming standard size paper 11 x 11½):

Side 1	top - 3/8"	
	bottom - 9/16"	
Side 2	top - 1/2"	
	bottom - 7/16"	

1. Set the top-of-form so the dot 1-4 row of line 1 is 3/8" from the top of the page.

2. Emboss all odd-numbered pages.

3. Page-advance twice and tear the perforated line that is just outside the slot above the tractor assembly.

4. Remove the blank paper from the tractors and return it to the delivery pile.

5. Turn the odd-embossed pile upside down and 180 degrees around. Set it on the delivery pile, feed it up to the tractors.

6. Press line-advance eight (8) times, then press top-of-form.

7. Set the first of the pages to be embossed under the embossing die. The upper edge of the die should be right on top of the second row of dots in line one of page one.

8. Remove the slack in the tractors by "snugging" the paper down under the embossing die.

9. Emboss the even-numbered pages, making sure if there is one more even page than odd that a blank page is at the end of the form to receive it. Do <u>not</u> allow the machine to operate without paper.

10. To reset the tractors for embossing of odd-numbered pages, press page advance once, line advance nine (9) times and top-of-form. Insert fresh paper so the page perforation is about 3/8" above embossing die edge.

Full-Page Paperless Braille Display

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The Rose Braille Display Reader, a full-page paperless braille display device, is now in the prototype testing stage of development. Under a federal assistance contract from the U.S. Office of Education, Rose Associates has built and is now testing prototypes of a full-page paperless braille display unit which will display braille materials of all kinds in conventional manner from data stored on magnetic tape cassette.

The Reader is a desk-top unit which is about the size of an attache case. Its display surface is exactly the same as that of a conventional braille book page. A blind user will simply insert a standard magnetic tape cassette into a slot in the side of the unit and then turn a short lever. Immediately, the first page of braille will appear on the display surface. To change pages, the reader simply moves the level back and forth through a short arc. The original display will be "erased" and a new page display will appear. The size of the page, the size of the braille cells, and the size of the individual dots, all correspond exactly to conventional paper braille today. The present design of the Reader permits up to 500 pages of conventional braille to be stored on one standard magnetic tape cassette, using only one track of the tape for braille data storage, so that the user will not be required to turn the tape cassette in order to obtain access to all data on the tape. The Reader will allow a blind user to read pages in consecutive fashion or to seek both backwards or forwards for specific pages chosen at random. For the blind reader, the display will be exactly the same as the format of conventional paper books, except that the volume of braille will now be contained in easily handled magnetic tape cassettes.

Rose Associates is now engaged in environmental and product reliability testing of the first prototypes. Over 9,000 cycles of failure-free life testing has already been carried out, which is equivalent to changing pages 9,000 times, and life testing will be continued indefinitely as part of a policy of building a unit which will be highly reliable. It is expected that by the middle of 1980 production models will be available for sale to the public. The initial price for a Rose Reader is expected to be $5,000, but it is expected that within a few years the cost of an average unit will be around $3,000.

Some of the functional capabilities which are planned as options for prospective users are: automatic page search, either by ink print or braille page number; computer interface connection; telephone terminal connection; braille keyboard option, for personal note-making; slave/readers, which are fed from a master Reader for classroom use; and portable powerpacks which will make the Reader portable.

Of equal important is the fact that a sister company, BRAILLE INC., of Falmouth, Massachusetts, U.S.A., will have ready for sale more than 50 works of current literature available on magnetic tape cassettes to be used with the Rose Reader. The price of an average book on tape cassette is expected to be about $15.00. Braille Inc., which now publishes one new braille book every month, intends to expand its publications schedule so that purchasers of the Rose Reader will have a large number of braille books available to them at reasonable cost.

Hopefully, starting in the middle of 1980, braille books on tape will begin to be as available for the blind as ink print books are for the sighted.

Recent Reports and Publications

Foulke E. *Reading Braille.*

University of Louisville, 1979, 50 pp.
This authorative paper examines the experimental data that permit inferences concerning the perceptual basis for reading braille, and considers some possibilities for improving the reading rate of the typical braille reader.
Copies are available, free of charge, from Dr. E. Foulke, Perceptual Alternatives Laboratory, University of Louisville, Louisville, Kentucky 40208, USA.