

# Accessible Music: The State of the Art





# **Accessible Music: The State of the Art**



**Transversal Programme:  
Mus4VIP project: Music for visually impaired people  
LLP - KA3 ICT: Multilateral Projects  
Project N° 530990-LLP-1-2012-1-IT-KA3-KA3MP  
Agreement N°. 2012- 4250  
May 2013**

This document is published by the Musi4VIP project Consortium

The project was made possible with the support of the "Transversal Programme: LLP - KA3 ICT: Multilateral Projects" of the European Union"

Musi4VIP project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

This document is also available on the Internet ([www.music4vip.org](http://www.music4vip.org))).  
Text completed in May 2013

© Consortium of the MUS4VIP project coordinated by Conservatorio di Musica Pollini di Padova, 2013.

The contents of this publication may be reproduced in part, except for commercial purposes, followed by the date of publication of the document and a reference of the Mus4VIP project.

Requests for permission to reproduce the entire document must be made to the coordinator:

Conservatorio di Musica Cesare Pollini  
Via Eremitani, 18, 35121 Padova - Italy  
Tel: +39 049 875988

## **Deliverable information:**

<b>Project number:</b> Project N° 530990-LLP-1-2012-1-IT-KA3-KA3MP
<b>Project title:</b> Music for Visually impaired people
<b>Deliverable Type:</b> PU
<b>Deliverable number:</b> D2.1
<b>Contractual date of the Delivery:</b> 30 may 2013
<b>Actual date of the Delivery:</b> 30 May 2013
<b>Title of Deliverable:</b> D2.1 State of the art
<b>Work Package contribution to the Deliverable:</b> WP2
<b>Nature of the Deliverable:</b> Report
<b>Authors:</b> All partners in the consortium.
<b>Abstract:</b> This deliverable INFORMS about the state of the art with regard the world of accessible music, Braille, didactics and computer tools.
<b>Keyword List:</b> Blind, music, education, computing, Internet, difficulties with existing systems, Braille music



# Executive summary

The main goal of "Mus4VIP" is to close the gap between Braille music and its non-sighted users.

This goal will be achieved by designing, developing and testing a new didactical methodology, capable of exploiting the new software, in an integrated educational context.

The project will also address the fragmentation in this area; this approach brings together different groups working in different countries. The project will develop a learning pathway that will promote wider adoption of Braille Music by encouraging its integration within mainstream environments.

The Mus4VIP project includes the creation of a web portal that offers teachers of blind music students methods of working, guides and didactic solutions to take full advantage of information technology.

The first work of the Consortium is, therefore, that of researching and analysing the various existing computer tools in order to provide a reference tool for the later stages of the project, when the teaching guides will be produced and we will evaluate the way in which existing computer tools can support teaching activities in the fields of music theory and instrumental study.

This report analyses the overall State of the Art and introduces the world of Braille music, Braille writing in all its complexity, as well as other musical codes in digital format. It also presents the BMML format in detail and describes other research initiatives that have previously been undertaken in these fields.



# Tables of contents

Executive summary.....	7
Tables of contents .....	9
Table of Figures .....	13
The MUS4VIP Project.....	15
Structure of this Deliverable .....	19
1. An overview of education for blind people .....	21
2. Relief writing system .....	23
2.1 Early attempts at writing for blind people .....	23
2.2 Louis Braille .....	30
3. Tactile musical writing .....	33
3.1 Learning Musical notation: how to turn music from sound to a tactile medium .....	33
3.2 Systems of tactile musical reading .....	39
3.3 The Braille music notation .....	49
3.4 The International Braille Music Handbook .....	50
4. Music and Accessibility.....	55
4.1 Introduction .....	55
4.2 Accessible information .....	56
4.3 How to make music accessible .....	57
4.4 Accessible music formats .....	58
4.4.1 Braille Music.....	58

4.4.2	Spoken Music .....	61
4.4.3	Enlarged Music .....	61
5.	Information technology in support of visual impairment .....	63
5.1	The Braille system and information technology revolution .....	63
5.2	Reading print compared with tactile and speech synthetic solutions .....	68
6.	Braille music, analysis of peculiarities and problems.....	73
6.1	The model for representation.....	73
6.2	Evolution of Braille music notation.....	74
6.3	The Braille music notation .....	76
6.4	Analysis of the use of contractions in Braille music .....	80
6.5	Analysis of difficulties in transcription from printed music to Braille music.....	85
6.6	Notating parts .....	86
6.7	Key signatures .....	89
6.8	Time signatures.....	92
6.9	Pitch and duration of notes .....	93
6.10	Rests.....	102
6.11	Chords.....	104
6.12	Clefs.....	106
6.13	More on the use of contractions in Braille music .....	109
6.14	Issues related to the reading and memorisation of music: why there is a need for an interactive system for blind musicians. ....	118
7.	BMML Development.....	131
7.1	BMML – the basics .....	131
7.2	Elements .....	131
7.2.1	Attributes .....	132
7.2.2	Data.....	134
7.2.3	id .....	134
7.2.4	“New line” and “space” characters .....	134
7.2.5	Duration of music figures .....	135

7.3	The BMML elements.....	137
7.3.1	Let's explore the BMML format .....	137
7.3.2	The <i>Note</i> element .....	141
7.3.3	Time signatures.....	143
7.3.4	Music clef .....	144
7.3.5	Bar line.....	144
7.3.6	Tuplet.....	145
7.3.7	Music Beams.....	146
7.3.8	Doubling .....	146
8.	Resonare: Braille music recognition software .....	151
8.1	Features of the <i>Resonare</i> program.....	152
8.2	How the <i>Resonare</i> editor works .....	153
9.	Existing research and projects on music and Braille .....	156
9.1	National and European Projects about music and Braille implemented in the past.....	156
9.2	Existing research and projects .....	157
9.2.1	Ebrass.....	158
9.2.2	Contrapunctus .....	158
9.2.3	i-Maestro.....	159
9.2.4	The Interactive Music Network .....	160
9.2.5	Accessible music maker.....	160
9.2.6	Play2 .....	161
9.2.7	Wedelmusic .....	162
9.2.8	Harmonica.....	163
9.2.9	Miracle .....	164
9.2.10	Braille Score .....	165
10.	Analysis of the results of the EU project Contrapunctus: copyright problems the braillemusic.eu web library.....	167
10.1	Analysis of web portal .....	167
10.2	Problems with the use of accessible information .....	168

10.3	Texts for blind people: the European legislation.....	171
10.4	Customs and practices in Europe.....	176
10.5	Possible solutions to copyright issues: Italy.....	179
10.6	Possible solutions to copyright issues: Poland.....	180
10.7	Possible solutions to copyright issues: UK.....	181
10.8	The Braillemusic.eu web portal: description.....	182
10.8.1	The Braillemusic.eu web portal: How to search.....	184
10.9	Conclusions concerning problems of copyright.....	188
11.	Conclusions.....	191
12.	Bibliography.....	195
13.	Web Sites.....	199

## Table of Figures

<i>Figure 1: Example of a page using the Haiiy system</i> .....	26
<i>Figure 2: Example of Moon characters</i> .....	27
<i>Figure 3: Example of a sonographic Barbier table</i> .....	29
<i>Figure 4: Image of the Braille cell consists of 6 dots</i> .....	30
<i>Figure 5: The national English hymn in Moon notation (source: RNIB)</i> .....	40
<i>Figure 6: TIGER Printer, for raised printings</i> .....	41
<i>Figure 7: The British national anthem in raised simplified notation (source: RNIB)</i> .....	42
<i>Figure 8: Giotto Glass Deco</i> .....	44
<i>Figure 9: Example of a raised staff</i> .....	44
<i>Figure 10: Musical Touching Slate</i> .....	45
<i>Figure 11: “Herkules” and “Corona” Constellations from Stockhausen’s “Sternklang” (1971)</i> .....	47
<i>Figure 12: Figure 12: Stockhausen: excerpt from Studie II (1954)</i> .....	47
<i>Figure 13: Picture of a Braille Typewriter, Perkins model</i> .....	49
<i>Figure 14: International handbook cover</i> .....	51
<i>Figure 15: Availability of texts in print in comparison with Braille texts</i> .....	59
<i>Figure 16: User at the computer reading an electronic document through Braille display</i> .....	60
<i>Figure 17: Optacon (source: <a href="http://en.wikipedia.org/wiki/Optacon">http://en.wikipedia.org/wiki/Optacon</a>)</i> .....	65
<i>Figure 18: Braille Display (source: <a href="http://www.braillet.net.org">www.braillet.net.org</a>)</i> .....	65
<i>Figure 19: Example of graphical music representation on a staff</i> .....	73
<i>Figure 20: Correspondence between traditional notation and a Braille score</i> ....	74

<i>Figure 21: Example with repetitive musical fragments</i> .....	76
<i>Figure 22: The 63 Braille signs arranged in their normal 7 lines</i> .....	76
<i>Figure 23: Correspondence between traditional notation and Braille in a piano piece</i> .....	88
<i>Figure 24: Capacity for visual selection</i> .....	119
<i>Figure 25: How the Resonare interface appears in a Braille score processing phase</i> .....	153
<i>Figure 26: Resonare software structure</i> .....	154
<i>Figure 27: Resonare Editor Interface</i> .....	155
<i>Figure 28: Home page for the portal <a href="http://www.braillemusic.eu">www.braillemusic.eu</a></i> .....	167
<i>Figure 29: Registration page on the <a href="http://www.braillemusic.eu">www.braillemusic.eu</a> web portal</i> .....	183
<i>Figure 31: List of composers into the archive</i> .....	185
<i>Figure 32: Advanced search page of the web portal</i> .....	186
<i>Figure 33: Page showing search results</i> .....	187
<i>Figure 34: The page that allows the user to upload a file</i> .....	188

## The MUS4VIP Project

The Mus4VIP project aims to develop the best possible use of new technologies in the field of Braille music, so as to prevent further disadvantage to visually impaired people and in order to reverse the dramatic decline in music literacy among blind people. In recent years there have, in fact, been signals (New York Times articles by Rachel Aviv, Published: December 30, 2009) of a serious return to musical illiteracy, due to the fact that new basic technologies (Ipad, smartphones, and similar technologies based purely on listening), have discouraged the visually impaired from learning Braille, offering them the easy, but poor, alternative of relying on learning by ear. This method is indeed very easy to implement; in fact today, the Internet allows the retrieval of almost anything, as well as offering immediate results. On the other hand, as we already pointed out in this document, it is also known that learning only on the basis of listening tends to limit the ability to conceptualize learning contents. In fact, hearing / listening recalls written symbols in those who are literate, while, for those who are not literate, it does not produce concepts, but only labile traces in the memory, which cannot easily be refreshed, corrected or enriched, through the continual, flexible and personal reference to a written source. This turns to be a very significant obstacle to genuine education, and denies the principle of equal opportunities.

Mus4VIP seeks to overcome these problems by exploiting the best of available resources, both in terms of the functioning senses (touch and hearing), and the best possible use of existing technology based on these two senses.

Mus4VIP will, therefore, derive maximum advantage from the sense of touch, which offers the only true means of achieving real literacy. By comparison the sense of hearing, gives an "overview" of a musical score but, crucially, it does not allow the same degree of accuracy in examining details. With regard to the available technologies, Mus4VIP will combine the use of tactile devices, such as Braille display and Braille embosser, with acoustic devices, including sound cards and speech synthesis.

The outcome of this will be to promote Braille music literacy, because hearing and touch will support each other in the complex process of deciphering and comprehending music as a language.

In particular, the project aims to:

- Develop an educational methodology that will attract students and support teachers in the field of accessible music.
- Offer the opportunity to develop training materials in a collaborative way, taking into account knowledge and understanding of the cultural differences between the various participating countries (each country has developed its own local Braille language, with small, but significant differences; the project will consider this aspect, by collecting and systematically organizing the differences between countries).
- Help young visually impaired students to develop a more attractive and accessible method for studying music, bearing in mind what an important contribution music can make to an individual's intellectual and psychological development.
- Help new generations of teachers, teaching assistants and lecturers to acquire specific basic skills in the area of accessible music, by offering them powerful resources and workplace opportunities, both in special schools and in institutions devoted to training the visually impaired.
- Develop, test and disseminate new teaching models in the areas of Braille music theory, reading and writing, based on the use of new technologies.

- Create a collaborative process among schools at the European level, aimed at improving both basic training and services for music teachers and other categories of people working in schools, such as teaching assistants for visually impaired students. The purpose of this collaboration is to exchange experience, with a view to developing new teaching strategies aimed at improving music teaching quality and the use of Braille both in schools and special institutes, particularly in those classes with one or more visually impaired students.
- Develop a guide to the use of available computer tools that will meet the training needs of teachers at primary, secondary schools of theoretical and practical subjects in music conservatories and music high-schools, considering the conditions of each participating country in terms of school integration and education provided by special institutes.
- Dialogue with projects and networks that operate on the same themes
- Improve the quality and European dimension of training for teachers of visually impaired students;
- Promote the development of contents, services, pedagogical solutions and innovative practices based on IT in the field of permanent learning.
- Improve the quality and European dimension of training for teachers of visually impaired students;
- Promote the development of contents, services, pedagogical solutions and innovative practices based on IT in the field of permanent learning.
-



## Structure of this Deliverable

If the goals of the Mus4VIP project are to be achieved it is essential that the consortium have a clear idea of the field within which they are trying to achieve these goals, namely, working with and improving the environments and processes which involve Braille music. Work Package 2 of the project assesses the potential currently offered by Braille music and other music formats for all stakeholders of Braille music. This includes the creators of Braille music software, the libraries who archive, file and search Braille music and the end users who consume it.

This state of the art deliverable is the result of research that has been undertaken in order to get a better view of the tools and solutions that can be used with blind children.

The purpose of this document is to provide information on:

- existing didactic strategies that use Braille Music
- existing software and technologies relevant to the world of Braille Music
- the Braille scores available in different countries,
- the different formats used by transcribers to produce and reproduce Braille music scores,
- the storage and state of conservation of Braille music scores,
- the distribution of Braille music scores,
- developments and European projects concerned with making Braille music more accessible,

- learning Braille music and the possibilities of e-learning technologies and initiatives,
- the legal aspects of copyrights concerning this project.

A significant part of this report is devoted to describing the results of European projects in this field, in particular Play2, eBRASS and Contrapunctus. This section will also consider the prospects that are offered, thanks to the development of a specific new format (BMML) and software packages that employ this format. These programmes, making use of already existing materials in Braille text format, facilitate the blind student musician's study of music and make it far easier for students and teachers to work together if one is blind and the other sighted.

The introductory part presents an overview of the world of accessible music and Braille transcription, and gives an account of the research activities undertaken to meet the specific needs of blind musicians.

The second part describes an accessible and friendly approach to the world of IT for blind people. It gives an overview of Braille music formats and describes the software BME2 and some other programs. Also included in this section is information on existing collections and archives as well as data on production and distribution. While Braille music is the main focus of the project, there is also additional information on formats such as Spoken music and Large Print music. The deliverable then provides an survey of who the main users of Braille music are and how Braille music is currently taught.

In order to ensure that the project does not reinvent the wheel, this report provides a section on previous work which gives an overview of the European projects that are relevant for the Mus4VIP project. It provides information about the projects, their objectives and results and their relation to Mus4VIP.

The deliverable concludes with a series of findings and recommendations based on the data that have been collated. These will be used both in the remaining work in Work Package 2 and the further research and development which will be carried out in the project.

# 1. An overview of education for blind people

The blind musician is a common figure in Western and other cultures. There are numerous examples of blind musicians who achieved great importance, in the past as today, like for example Francesco Landini (who lived in the XIV century and was known as "the blind man of the organs")

The education of blind people, once systematised, was organised on the basis of "segregation", resulting in an education system for blind people that was separate from the rest of society. Educational institutions for blind people included, in most cases, musical studies in their curriculum and there were music specialists working in most of these institutions who could transcribe music into Braille. Training to be a musician gave a blind person a good chance of making a living in their adult life since, in this period, societies required musicians for church services, family gatherings and many other events.

Towards the end of the 1960s, Italy and some other European countries started to move towards a greater integration of blind and visually impaired students into the mainstream school system. Whilst this move had many positive effects it, nonetheless, brought about a serious decline in the musical education of blind people.

This decline was also found, but to a smaller extent, in segregated educational institutions and is explained by the following factors:

- The distance between common musical notation and Braille musical nota-

tion;

- The consequent difficulty of finding music teachers trained to teach blind young people;
- The complexities, long preparation times and high costs of transcriptions;
- The tendency to use fast methods and "shortcuts", such as learning music from recordings or from a teacher demonstrating the notes of a piece. As a result, students do not develop their manual and analytical skills, and their capacity for independent learning is severely reduced.

One can still try to respond to this situation by spreading correct knowledge, preparing the music teachers to address specific problems (which are less insurmountable than might be imagined) and activating a network of services and initiatives that can create synergies, experience and innovation.

One of the objectives of the Mus4VIP project is to link the commitment to study and research to the ethical and civil objectives that inspire all educational programs as well as general educational policy. From this perspective, it emphasises a technological, organizational and human sustainability, and gives blind people an irreplaceable opportunity to access music and music history, as well as providing a fully accessible medium for their own musical creativity.

## 2. Relief writing system

### 2.1 Early attempts at writing for blind people

One of the earliest techniques of writing for blind people was relief writing (also sometimes called anaglyptic writing<sup>1</sup>). This is made of raised signs that are read by touching them.

The earliest reference to a specific interest in the communication problems of blind people can only be traced to the sixteenth century.

A comprehensive study, consisting of books, photographs and other artefacts, of the various solutions devised over the years, and organised in a systematic manner to enable the scholar to trace the history of typhology, has been created by CIDAT of ONCE (Organización Nacional de Na-Ciegos Españoles) from Madrid. There is also another study, less extensive but still significant, at the Cavazza Institute of Bologna (IT), where one can see instruments for blind people, made at various times starting from the second half of the sixteenth century.

The Cavazza Institute has also published a brief history of the methods and tools that are displayed in the exhibition.

The very first attempts at relief writing date back to about 1517, when Francesco Lucas of Zaragoza developed a system based on characters printed on thin wooden tablets. Introduced into Italy in 1575, this method was improved by the Roman Rampanseto, who made larger and hollowed letters.

---

<sup>1</sup> From the Latin anaglyptus, "chiselled"

Similar techniques were almost certainly used prior to this, since it is simply a matter of reproducing the same information by the raised letter method or by inlay.

Many experiments and solutions were tried but they achieved little success with blind people. Among these we may recall the Italian abbot Francesco Lana de Terzi, who devised a complicated system of twisted and knotted wires representing the different letters of the alphabet. He was a mathematician and naturalist (he is also called the “father of aeronautics” since he proposed the first serious attempt of making a flying aircraft lighter than air). He collected his ideas in a paper entitled "Prodomo", an essay presenting his inventions, in Brescia in 1670. It appears, however, that his idea was never put into practice, but it was undoubtedly the beginning of the tactile writing system, typically used by blind people.

Lana's system and many other subsequent attempts came from the desire to use secret writings. This was partly for military purposes but also secret writings were one of the most popular pastimes in the Seventeenth and Eighteenth centuries.

In 1640 the French typographer Pierre Moreau developed a method of reading for blind people based on a combination of moving letters. Many others tried similar techniques, with greater or lesser success, using all sorts of systems and tools to produce a recognizable tactile representation of the common alphabet.

From the second half of the Eighteenth century some French intellectuals were involved in these issues. Their intention was to demonstrate the validity of a range of texts which went against the official thinking of the time, in particular:

- a) that social conventions were not immutable, but they were the result of a particular structure of society, typical of an age and, therefore, changeable;
- b) that the human being was able to adapt to extreme conditions and, above all, that knowledge and intelligence – the ability to understand concepts - could grow and develop even in people of lower social class, disabled and the poor.

It was the assertion of the concept of "freedom", which was the basis of both the American Revolution and the French Revolution. (see Diderot - *Letter on the*

*Blind for the Use of Those Who See).*

It was in this period that the first really practical method of writing was invented, by Valentin Haüy, a career diplomat, connoisseur of many languages and philanthropist. On the basis of the previous attempts, Valentin Haüy, following the logic of "approval" (what works for the majority of people has to work for minorities also), adopted a high relief concept and enlarged the letters of the common alphabet. He got the idea from observing some blind people who earned their living by begging. He noted their reactions after touching the coins received as alms. Haüy noticed that beggars could distinguish the image of the currency using their fingertips and in 1784 he developed the first method of tactile raised reading. From then on, it was possible to construct a real school curriculum, which included the study of language, arithmetic and other subjects. Of course, before this period there have been literate blind people: in the field of music, for example, Francesco Landini (XIII century) and, in mathematics, Nicholas Saunderson (1682 - 1739) who was born blind, and who succeeded Isaac Newton as a holder of the Lucasian Chair of Mathematics at Cambridge University.

Valentin Haüy, who among other things was a pupil of the blind abbot Michele de l'Epee (1712-1789), became, in 1784, the Founder and Director of the Paris Institute for Blind People thanks to the success of his method. His system worked by creating a raised impression of the alphabet letters on rather thick paper, over which he ran a pen tipped with a small toothed wheel. Besides this, he tried to emboss letters on slightly wet paper utilising metal plates, on which were inscribed the letters themselves. Work, done in this way took a long time, was tiring and, above all, only made reading possible, while it was practically impossible for blind people produce written texts.

Yet, using such a system, in 1787 he was able to write his first book that was a synthesis of his ideas and theories about the education of blind people.

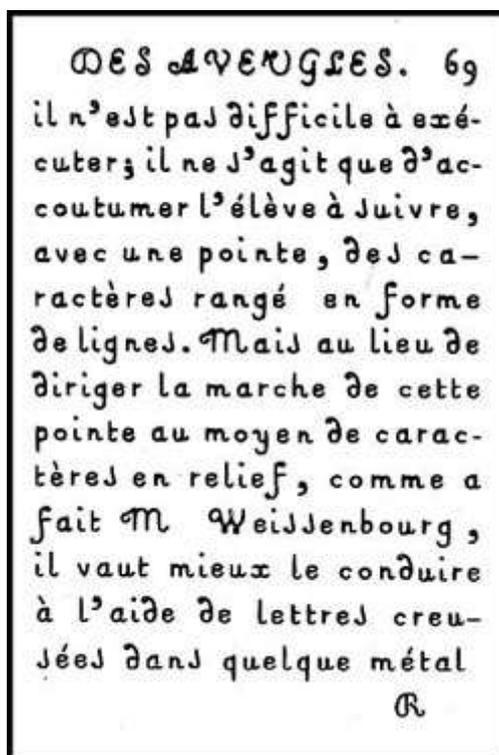


Figure 1: Example of a page using the Haüy system <sup>2</sup>

His merit lies primarily in having been the first person to conceive of a general plan of education for blind people based on the teaching of reading using cursive raised letters that blind persons would read by touching them with their fingertips. He also made important observations concerning the physical characteristics of the index finger of the right hand, notably the sensitivity of its tip, thus laying the foundations for an alphabet that would be designed around those anatomical characteristics.

It is clear from the above that Haüy's main focus was to promote the integration and communication between blind people and normally sighted persons. It was possible since the forms of his texts for blind people were only slightly different from traditional ones.

---

<sup>2</sup>Copy of a page of the Haüy system kept at the Museum of the American Printing House for the Blind - [http://www.aph.org/museum/first\\_book.html](http://www.aph.org/museum/first_book.html)

It is clear that Haüy believed in the principles of inclusive education, that are now widely accepted and shared, as well as the concept of *access for all*. As for writing, however, the great effort of text learning and recognition by the use of touch, that was asked of blind people did not justify the application of such principles at all costs, but a differentiation in mode, even if not in the rules. It would have been more acceptable had it led to a greater speed of reading and learning. Other disadvantages of the system lie in the fact that blind people were precluded from writing, and also such a system was strongly focused on a perception that was imitative of that of normally sighted persons. In conclusion this system, with the many hand movements that were needed for reading, with its complexity and the motormental efforts which it required, needed real improvements and adjustments that were eventually made through the efforts of educators such as Klein, Ballu, Gal, Alston, Frere and especially Moon.

In 1817, Klein and Ballu replaced the continuous lines with dotted lines. This gave increased comprehension by touch but it also increased the complexity of writing.

William Moon went blind at the age of 21 and so he developed a system of learning and reading that took his name. It was in this way that the "Moon" system was created. It was very similar to the Haüy system but more functional because only 8 letters remained the same as the traditional ones, while 14 were modified and 5 completely redesigned. A first book was printed in 1847 using the "Moon" system had a great success, so great that it was thought that the problem of communication for blind people was finally solved.

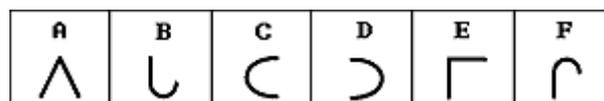


Figure 2: Example of Moon characters

Today the system is used mostly in the Anglo-Saxon world and some argue that it

is preferable to Braille for people who have gone blind later in life. Such was the success of the Moon system that a musical syntax was also created (see below).

And finally we arrive at the Braille system, but before doing so it is worthwhile to mention the system that is considered its major precursor: that of Charles Barbier de la Serre's. He was a captain of artillery at the time of Napoleon Bonaparte. His system, invented in 1808, used a script made of dots instead of lines, because they were more recognizable to the touch. It consisted of a formation of two vertical columns of six dots each. It was possible to have a maximum of 12 dots for each symbol. The system was called a "sonographic method" because the symbols did not represent single letters, but rather the different sounds of the French language. It is curious to notice that he designed this tactile writing system to allow officers to decipher secret messages in the dark. The system was tested in 1821 at the Institute for Young Blind People (Institution des Jeunes Aveugles).

But even such a system was not immune to defects. With 12 dots the possible combinations are some 4095 ( $2^{12} - 1$ ), far too many for even the combinations of sounds that can be played and for existing characters. Moreover, since it is a system based on sounds, it does not include punctuation signs nor mathematical symbols. Finally, the space required to represent the 12 dots is too large for the sensitive part of the fingertip with the result that the blind were required to make continuous movements of the finger on the text, and this obviously greatly reduced the reading speed.

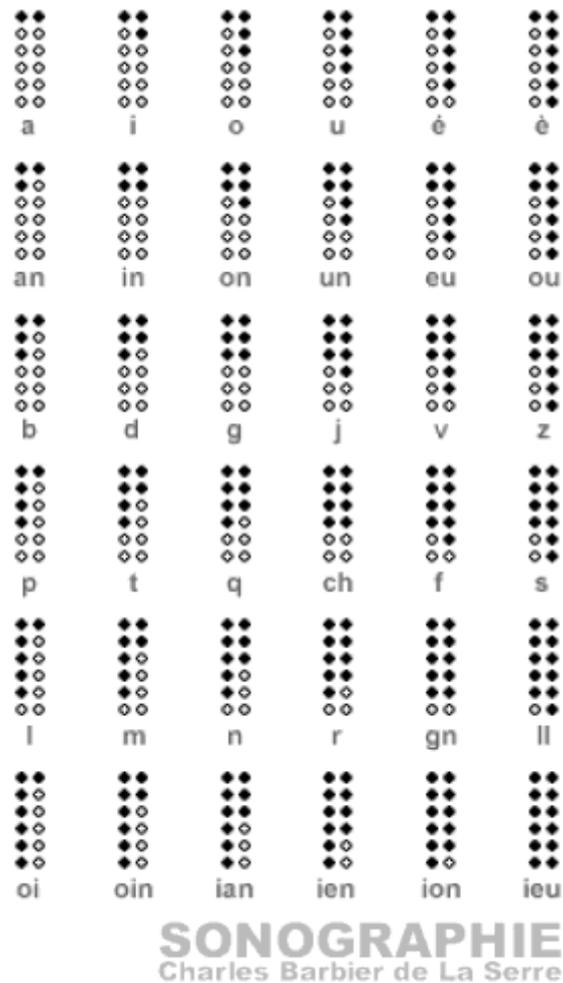


Figure 3: Example of a sonographic Barbier table<sup>3</sup>

Although it was quite complicated, in the Barbier system, to decode signs and translate them into words, it had the merit of paving the way for the modern method of reading and writing for blind people, created by Louis Braille. Also, for writing with his own code, Barbier designed and created the slate and stylus, very much as we know them today.

<sup>3</sup> Image taken from: <http://rocbo.lautre.net/orthog/sonographie.html>

## 2.2 Louis Braille

Louis Braille went blind at the age of three years as a result of an accident in his father's workshop. His father was a blacksmith. Braille hurt his eye with an awl and, despite treatment, the infection in the wounded eye soon also affected the other. Louis Braille lived in Coupvray and attended the public school for a year. He was especially helped by his father who, together with of his sister, carved the alphabet letters on wood until the age of 10 years. Then Louis Braille was welcomed to the French Blind Institute, where he remained as a teacher until his death in 1852. He became very adept at Barbier's system and this ability made him understand its limitations and also suggested a solution to him. Braille reduced the matrix of each sign to two columns of three dots each, enabling him to represent as many as 63 characters plus the space. The 1, 2 and 3 dots were numbered in the left column, while 4, 5 and 6 were in the right one.



*Figure 4: Image of the Braille cell consists of 6 dots*

The system was - and still is today – structured as follows: the 4 dots of the upper part stand for the first 10 letters of the French alphabet (it is called the first series). By adding dot number 3 and keeping the same organization of the first 10 letters it is possible to represent the letters from the eleventh to the twentieth, with the addition of dots three and six, from the twenty-first to the thirtieth and onwards to the fortieth with the number six. The other 10 signs are obtained using only the lower 4 dots, then only the dots of the right column and finally the last 6 remaining signs that fall outside the above-mentioned organizations. So, 63 signs were

created to represent letters, numbers, punctuation, music and mathematics. Thus was born a system for reading and writing that was absolutely similar to the common one, but this had very precise rules of interpretation, which compensated the shortage of available symbols.

The system was published in 1829 and it was a great success among the blind of the French Institute. Professor Pignier himself, Director of the Institute, nominated Louis Braille as a teacher.

Writing tablets were made, adapting the instruments originally used. Reading and writing were now possible with excellent results.

The Braille system was also used for music since Louis Braille attended musical studies in organ at the same institute.

As the biographies tell us, Louis Braille didn't achieve early success since his system was opposed by the teachers of the Paris Institute. The most critical moment came when Pignier, the director of the Blind Institute, was replaced by Dufau who abolished the Braille system. He adopted instead the one developed by John Alston at the Glasgow Blind Shelter, a sort of normal alphabet, much simplified and reproduced in relief.

Dufau imposed the use of the Alston system and also the elimination of the writing tablets (they were considered a problem) and the elimination of the few books available (including a three volume history of France, the first book in Braille).

Despite these prohibitions, the students kept on using the Braille system making use of little knives, forks and pins. The older students taught the younger ones. In this way, despite punishments and prohibitions, the Braille system lived on.

There was, however, an improvement in this sad situation due to Joseph Gaudet, Dufau's young assistant, who was able to convince Dufau. Later there was further opposition, but nothing as strong as Dufau's.

Louis Braille died in 1852 at the age of 43 in poverty. The success of his system was rapid and unstoppable and it spread throughout France and Europe. Braille had adapted the signs of his system for six languages: English, French, Spanish,

German, Italian and Portuguese.

In Lausanne, the Braille system was adopted as the official method, and in 1860 a copy shop for Braille books in French and German was founded.

In 1854 the Braille system was officially adopted in France and then in Portugal.

In Germany the Braille system underwent some variation in graphic signs, which produced considerable confusion since 14 out of 25 schools adopted the adapted Braille system, while 11 used the original method derived from the French system.

In England four reading systems were used: those of Moon, Frjy, Alston and Gall. In addition, there were two other systems of shorthand type (Lucas and Frère), but eventually, in 1870, users decided to adopt the Braille system.

Finally, in 1878, at the International Congress for Blind Education in Paris, the Braille system was universally adopted as the method of reading and writing for blind people.

In the same period the Braille system was officially adopted in the United States of America too, despite differences among educators.

The most common criticisms of the Braille system were related to the difficulty of reading for blind people (these criticisms came from normally sighted persons such as the Klein educators of the Vienna Blind institute and Knie from Wroclaw) and the fact that the system tended to marginalize the blind, as collaboration and study with other classmates was limited.

## 3. Tactile musical writing

### 3.1 Learning Musical notation: how to turn music from sound to a tactile medium

Admittedly, thousands of pieces are played every day without any form of notation, since many players learn music "by ear". In this way, only the essence of the piece is preserved. From one performance to another, small changes will creep in, as new performers change what they have learned by listening, either deliberately or accidentally. If this is true for everybody, then it is of much greater significance for blind people. The Hungarian Markus Norbert, a blind and renowned jazz pianist, states (in the report on "*User needs*" of the European project eBrass - (2006-2008)<sup>4</sup>, that the Braille system is extremely deficient for Jazz music and that scores are very rare. So, according to him, the only way to learn and perform jazz pieces is through patient listening to recordings, and then playing them "by ear".

Taking a quick look to other musical notation systems, for example in the Far East (especially China, Korea, Japan and India) traditionally music is written indicating its pitch and the symbols are derived from the alphabet. There are additional signs for duration, dynamics and special effects, such as the way in which a stringed instrument or drums have to be played. It is understandable that in such systems also the graphic sign becomes a descriptive element of music and therefore is not accessible to blind people.

---

<sup>4</sup> Ebrass: European project - <http://www.ebrass.it/>

Similarly, in Western Countries, although the musical notation has a long tradition dating back to the ancient Greeks (who wrote music using letters) our system of modern notation only started in the seventeenth century. Before then, the notation systems used differed from ours both in the indication of rhythm (through a mensural notation) and pitch (shown in the tablatures).

In our musical culture notation has become very important, indeed indispensable for both composers and performers, as the length and complexity of many “classical” works make playing by ear impossible even for the most talented.

How else could a composer convey each section of the score to a large number of musicians involved in the performance of a work, if not through musical notation? The traditions of “classical” performance generally prize accuracy and fidelity to the composer's intentions, an objective that is hard to achieve when learning by ear.

These brief remarks should be sufficient to underline the fact that the meaning of notation varies from one musical genre to another, and that the ability to read music - and the much rarer ability to write it - can be either an imperative, or an insignificant aspect, according to personal musical disposition, the purposes of the performance or to the degree of accuracy required by a particular genre.

Let us now consider how the specific problem of musical notation for visually impaired people is placed within this broad scenario. Clearly, in cases where the “formalized” notation is not used, there are no particular difficulties for blind musicians: people who are visually impaired or blind from birth, or with minor disabilities, could be at an advantage as a result of the enhancement of their other faculties, for example, the sense of “perfect pitch” or a good memory, proverbial features whose existence is confirmed by research.

In the past, before the birth of the Braille system, blind musicians solved the problem in one of the following ways:

- a) In the case of a piece to be played, learning it by ear;
- b) In the case of a composer, performing the composition and entrusting to others

the task of transcribing it, or by using different systems of raised representation of common musical notation.

In its most simplified version, the last option has involved the use of readers or writers, or mediators in all periods of musical literacy up to our own times, and a wide range of blind musicians used it.

Nevertheless, there have been several attempts to convert visual music to a tactile medium. During the eighteenth and nineteenth centuries, for example, Hazy (in France) and Mahony (in America) were among those who invented systems based on raised alphabet letters, with the addition of various appendices (additional signs to letters, sort of tags, stem). The main disadvantage of such schemes was the extreme difficulty of writing music manually.

This problem was overcome by those systems that were based only on “dots” like the “Tangible Musical Notation” published in 1873 by Wait, later Superintendent of the New York Blind Institute.

In this system the information was conveyed through combinations of 8 dots, which were distributed in two consecutive squares on the page. This method used space in a less efficient way than the code invented 40 years earlier by Louis Braille.

Another 8-dot music notation which followed the invention of the Braille system was the notation designed by Gabriel Abreu Casta’no in Spain<sup>5</sup>. The system was based on the 8-dot cell consisting of two columns of 4 dots each, which gave 256 dot combinations. The system proved highly efficient and economic, making it possible to represent any note by one symbol. It also allowed the combination of notes with lyrics, using the three lower rows of dots to write letters and to make them easily distinguishable from the notes. Gabriel Abreu published his work in

---

<sup>5</sup> Reference: “Muzykografia Gabriela Abreu Casta’no – historia i zastosowanie” (Braille music notation by Gabriel Abreu Casta’no – history and application” by Dr. Esther Burgos Bordonau, translate into Polish by Helena Jakubowska – an article published in the quarterly “Nowy Magazyn Muzyczny (New Music Magazine) No. 25/2008 issued by the Edwin Kowalik Music Society.

1858. His 8-dot music notation gained a number of users and was still being used in the 1950s. It did not survive, because, according to some scholars, it did not get as much support and promotion as the Braille system.

Despite the proven effectiveness with which the Braille system is able to manage the most traditional notational forms, its adoption was opposed.

This can be partly attributed to the fact that the great majority of people who lose their sight are old people. For them the tactile Braille system (or any other similar method) is not considered an appropriate choice. But even among those who are literate in Braille text, it is estimated that less than 3% are regular users of a musical code<sup>6</sup>.

One could say that this is a reasonable figure, a mere effect of the low incidence of musical literacy in the total population, if it were not for the fact that blind people are often musically skilled and that music seems to be particularly important as both professional and leisure activity, not to mention that in Italy before the closure of Institutes and special schools, music was a compulsory activity for all blind people. So, how is it possible to justify the low number of Braille music users?

The most popular theory cites the complexity of the current system, which can be fully utilized only by those:

- who lost their sight in childhood and fully learned the Braille writing method;
- who are musically gifted;
- who had the opportunity of receiving an education based on Braille music by competent teachers;
- who have maintained their skills as professionals and / or teachers.

Given that the number of people who possess all these qualities, as well as a good memory, a good tactile sensitivity and the mental and physical coordination

---

<sup>6</sup> Estimate detected by the evaluating questionnaire of the eBrass project.

needed to manage Braille, is low, it is inevitable that the number of people able to use Braille music is limited.

Through the survey conducted for the project eBrass it is clear that the number of Braille music users is set to decline further as only very few children are learning the notational system, and this is due mainly to the following conditions: the number of children who are studying Braille music is decreasing because of recent changes in the educational system, so that a growing number of blind children, including the very talented ones, are educated in traditional schools rather than in the special ones that in Italy (apart from two isolated cases) have been abolished. The Italian integrated schools, starting in primary school, include musical activity on a limited basis (one or two hours per week), and this activity is carried out in the form of playing with sounds, rhythm and song. It should be added that virtually no music teachers have any knowledge of the Braille music code. This is understandable, but similarly (and this is more serious) the specialised support teachers barely know literary Braille and a fortiori the Braille music code.

In those European Countries where school integration is just beginning, children at special schools have a greater opportunity to study music and Braille, as was the case in Italy 40 years ago, although one should note the new trend and requirement to educate blind children in a comprehensive manner in all disciplines and not only in music, which is now considered as one opportunity among many.

The survey conducted as part of the eBrass project showed also that in those Italian Conservatoires where there is a blind student, there has been little attention given to Braille and its teaching, and this situation is exacerbated by the fact that none of the existing training courses is a specialist one, such as ones for support teachers. The same is true for University musicology courses and for the Conservatoire courses that offer teaching of music and Braille notation, even if limited to the minimum competency for its understanding and use. In Italy, the first courses for support teachers included a basic course of general Braille reading, while the recent courses directed by Universities called SISS - SOS (currently suspended for re-organization) in some cases, such as in Veneto region, have also scrapped

this part of the program. Finally, as mentioned above, Italian legislation does not provide for the presence of support teachers in Conservatories, and of learning support assistants also (sometimes known as assistant lecturers), since these schools are considered non-compulsory schools.

The only exception is the three-year first degree course offered by the State Conservatory of Padua - "Music Teaching: Methodologies and musical techniques for disabilities".

A further problem is due to the lack of updated material (Braille scores and didactics texts) both for teachers and for students and parents.

From the above it is clear that the vast majority of blind people (and to some extent also the severely visually impaired) are musically illiterate, and the number is expected to increase in the absence of an appropriate intervention.

Although we assume that it is a fundamental right of all blind people to have access to written music adapted to their needs, aspirations and capabilities, we also find cases in which people are satisfied with a level reached "by ear".

However, it is the duty of music educators in primary and middle schools where blind children are registered to ensure their access to an appropriate form of musical literacy.

Although adequate access to the study of Braille notation may be possible for young blind people who can read Braille easily, it is, it is very necessary that, in case of subjects with more complex needs, a varied set of approaches should be adopted for the introduction of Braille method teaching.

For example, in the case of people who have lost their sight as adults and who refuse Braille, or in cases of people who have a poor sense of touch, or in case of children who, for various problems (psychomotor, learning retardation etc.) have great difficulties with Braille, but have good skills in playing and / or singing, how could they handle pieces already studied, or learn something new?

The easier solutions are those linked to a mediator, someone who can read music for them, and in fortunate cases there is the help of a good ear. However, there is a

strong need to have different forms of notation in addition to Braille since it is necessary to learn music in the manner most suited to one's needs.

The Braille music notation system, although better established than others, has nonetheless contributed to improvements in other systems. This is a continuous process of development that could lead in the future to the identification of new solutions for different needs.

### 3.2 Systems of tactile musical reading

In this paragraph we will start analysing tactile music coding solutions that have had some success in the past up until the arrival of the Braille system which has become the critical system adopted universally. Recent technological advances have produced tactile instruments based on "Labile Braille"<sup>7</sup> that are increasingly reliable and have inevitably contributed to the establishment of Braille in all fields, including music.

Let us start by listing the main method that also developed a musical syntax notation using alphabet letters raised on paper. This is the Moon system, still used today in the Anglo-Saxon countries. It is a very good system for people who have lost their sight in later life and who are eager to read music as beginners, or for the first time. In certain cases, one could use the Moon system with children who, for various reasons, have not been successful in learning the Braille system, and in this field, the Anglo-Saxon literature offers many positive experiences.

As an example of a musical Moon text here is a simple fragment available from the RNIB<sup>8</sup> website - the British national anthem.

---

<sup>7</sup> Braille Labile: this means the continuous appearance and disappearance of raised dots on the appropriate computer peripherals. It is also called a Braille Display.

<sup>8</sup> *National association of UK Blind people: Royal National Institute of Blind People*

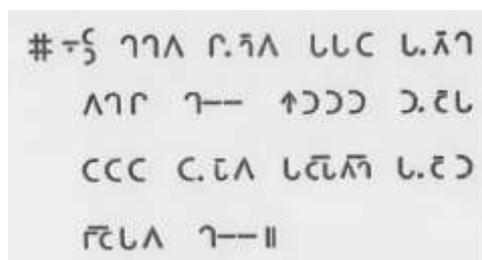


Figure 5: The national English hymn in Moon notation (source: RNIB)

The key signature is composed of a single sharp at the beginning of the first line, so the song is in the key of G major. Next comes a sign (a horizontal line and a dot below it), which indicates the time of  $\frac{3}{4}$ . The notes are represented by letters (in the Anglo-Saxon world notes are represented by the letters c, d, e, f, g, a, b), which in this example are crotchets (*quarter note in American English*). Those notes (as in printed music) could be followed by the dotted note, or by a horizontal line that increases the duration of a crochet (quarter note). These devices can be “doubled” to indicate respectively a double-dotted crochet (quarter note) and a dotted minim (half note). Two quavers (eighth notes) or more can be grouped under a single line in the same way as they would be beamed together in printed music. The reader proceeds on the assumption that the subsequent pitches are the closest available, unless there is an arrow that points upward or downward so as to direct the melodic line (as the one found at the beginning of bar 7) to the higher or lower octave. The bar lines are represented by white space, the double barline by two vertical lines.

The Moon system was originally used by people who wanted to read music rather than writing it. Thanks to various research initiatives, it can be easily reproduced by blind people thanks to personal computers and writing programs. The symbols are designed by using specific fonts, or graphics programs may be used. For example, once the document is printed on chemical paper (a special paper called *swell* or *stereocopy* - which will be discussed later) by laser or ink printer, it is

passed through a tool called a tactile image maker, in effect a little oven (a model is the P.I.A.F. PICTURE IN a FLASH produced by Quantum Technology Pty Ltd) that, by using a powerful bulb, heats the black parts that swell to become raised images.

Another very useful tool for the Moon system is the new printer Tiger produced by the American company ViewPlus Technologies, which is basically a graphics printer that reproduces raised documents.



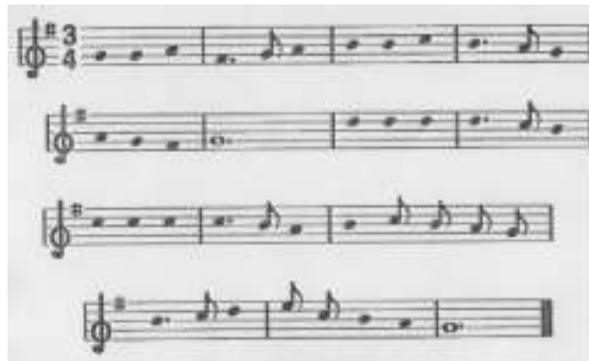
*Figure 6: TIGER Printer, for raised printings*

A further method of musical reading is achieved by reproducing the traditional notation in relief, using various solutions to simplify the signs.

This type of notation was used for a long time, despite its complexity of realisation and understanding. In fact, doubts about the possibility of producing a tactile replica of what appears in print still exist, as many scores contain a vast array of complex information reproduced in a very confined space, which would surely confuse even the most refined fingertips.

Thanks, however, to an appropriate level of enlargement and also to the simplification of many print symbols, raised line notation could be a useful solution. The following example shows once again the melody of the British national anthem: the G clef (or treble clef) has been simplified to a vertical line on a circle, and crotchets (quarter notes) and minims (half notes) are written without stems. Semi-

breves (whole notes) are indicated as empty rectangles to differentiate them from minims (half notes).



*Figure 7: The British national anthem in raised simplified notation (source: RNIB)*

Music printed in relief can lead to significant difficulties for quick reading, depending on a number of factors such as:

- The size of the staff, too broad to be examined by the fingertip in a single pass, requiring a complex zigzagging while browsing the page,
- The number of signs, which can be considerable if expression marks are included.

Despite these difficulties, we think that the system of raised lines should not be abandoned. Variants of this method of representation have been made, such as reducing the staff lines to 3 since this is sufficient to indicate 7 notes and can be moved upward or downward using clef changes. Also, to make the system more legible, the staff could be made with a lighter rise while notes could have smaller heads and a bigger rise.

The efficacy of the system is most evident in the case of adult blind people who are already familiar with standard printed notation and have real problems in learning Braille.

Another good reason to teach conventional notation to the blind student affected

by early impairment, at least in its fundamental aspects (use of staff with lines and spaces), is that it enables them to participate in educational activities together with sighted contemporaries, where reference is made to the typical graphic elements of the common notation in lines, spaces, cut note and so on. We should not forget the importance of verbal interaction in the classroom setting, even with limited vocabulary: indeed, it is a good opportunity for the exchange of roles within the group, and therefore also to promote a positive image of blind children to others, and to themselves.

In the case of blind children who start studying an instrument at an early age (6-7 years) and who still are not familiar with Braille, it is useful to teach them reading on raised staff, both for an initial understanding of the notes and for successful class integration. An excellent method of learning the notes on lines and space is to use the hand, where one can easily find the 5 lines (fingers) and 4 spaces (between the fingers).

By combining this game with reading on a raised staff, one can achieve a good solution for the learning of conventional printed notation, although this is still limited to a few introductory elements and it is not useful for the reading of complex scores in an advanced stage of study. Indeed in early years, for instrumental study and the reading of exercises, the use of the ear and the help of a music teacher remain the most suitable solutions, until the moment comes when the young student learns Braille and then Braille music.

Below are some examples of raised notation made by the writer for a blind child who began her piano studies at 5.

The examples were made with special pens designed for raised writing: they are used for both fabrics or glass, but there are other products created as toys for everyone, that can make colourful raised drawings, such as the "Giotto Glass Deco".



Figure 8: Giotto Glass Deco



Figure 9: Example of a raised staff

Among the preparatory aids for the study of music, we can mention the "musical touching slate", created by the tiftotecnic Office of Milan of the Italian Blind Union. It consists of a Velcro tab, on which you can put structures and signs of the conventional musical notation, such as staves, notes, accidentals, ties, clefs, etc. The figures are made of reinforced cloth and provided with a strip of Velcro so they adhere to the slate. Velcro facilitates both the positioning of the figures and their corrections. The slate is a very good tool to communicate with sighted people. Here is a photograph of a musical page composed with this system, with its symbol storage box.



*Figure 10: Musical Touching Slate*

In this review it is also important to talk about the representation of modern music, in which, in many cases, the graphic line's aim is to evoke the interpretation of a performer as a visual phenomenon.

In this case, one might presume that there would be no possibility of adaptation for blind musicians, and that they would be excluded from reading modern music, apart from isolated cases, such as the two works reproduced in raised notation by RNIB. The first of these, reproduced without the intervention of any mediation, is a piece from Stockhausen's *Sternklang* (1971), in which the arrangement of the two constellations, "Herkules" and "Corona" are represented by dots on a page to be played as notes, the size of which corresponds to their dynamic intensity.

Each constellation is contained in a frame and placed on two horizontal lines, which indicate predetermined pitches. "Herkules" includes five notes: the first is set between the lines, the second follows almost immediately above the upper line, the third is lower and is set on the upper line, the fourth has the same pitch and greater intensity and the fifth note is located on the lower line. "Corona" is composed of six notes describing an arc starting from the upper line. Notes two, three and six are of the same intensity, while note one is lower and note five is stronger.

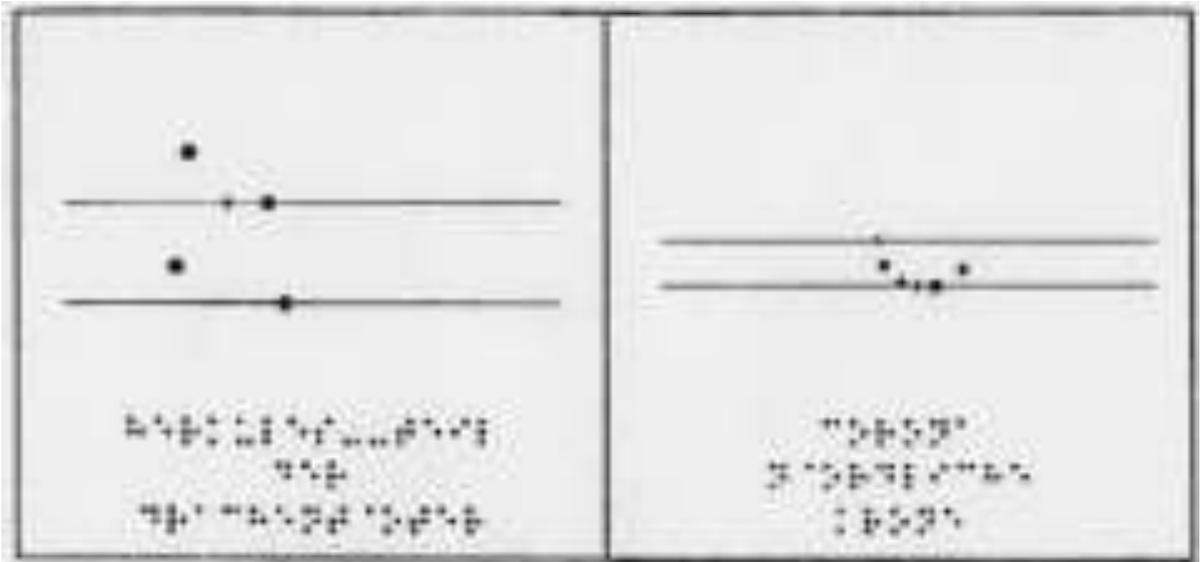


Figure 11: “Herkules” and “Corona” Constellations from Stockhausen’s “Sternklang” (1971)

Other scores may require some simplification before being produced in tactile form. The example below is also by RNIB:

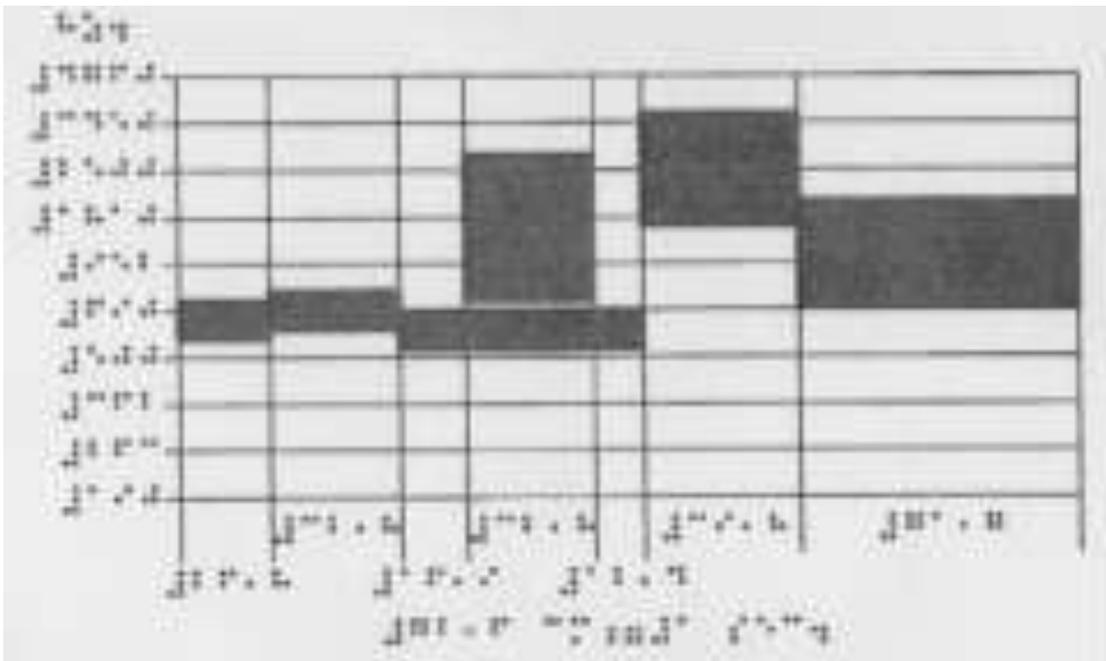


Figure 12: Figure 12: Stockhausen: excerpt from Studie II (1954)

This second example is an excerpt from Stockhausen's second Electronic Study (1954) that - according to the composer's preface - was the first electronic music to be published. Frequencies are represented on the vertical axis and tempo goes horizontally from left to the right. The overlaying rectangles in the grid frequency/tempo correspond to a "note mixing". In this case the main simplification is the reduction to a fifth of the horizontal lines, which indicate the different frequencies.

As an alternative to Braille it is worth mentioning spoken music (which is described in a more detailed way in later chapters). It could be either an alternative to Braille or a way that complements Braille in the access to written music; in particular "spoken music" might help to overcome certain difficulties with the retention of Braille signs, while Braille reading itself, integrated with spoken music, could reveal those details in the score that might not be conveyed through a spoken musical code.

The Dutch FNB<sup>9</sup> has developed a spoken music editor<sup>10</sup>, based on the DAISY standard<sup>11</sup> that allows you to surf the score.

An advanced alternative, in the field of spoken music, is to offer the reader the opportunity to listen, wholly or partly, to the music through a sound card, integrating in this way the spoken or Braille information with the listening.

A reproduction of spoken music can be of the following type: "*C half note third octave low on the first bar, followed by eighth note rest, dotted A quarter note legato to the next*" and so on.

---

<sup>9</sup> The FNB is the Braille printing office in Amsterdam, and today it is called DEDICON.

<sup>10</sup> Spoken Music: Enhancing Access to Music for the Print Disabled, David Crombie and others, ICCHP '02 Proceedings of the 8th International Conference on Computers Helping People with Special Needs, Springer-Verlag London, UK © 2002

<sup>11</sup> The "Daisy" format allows the user "to surf" the book through links as in hypertext, making its use similar to that of common printed texts.

### 3.3 The Braille music notation

We conclude this part by presenting Braille music, the syntax of which will be discussed extensively in the following pages. In this section we propose simply to highlight the main factors that have contributed to its diffusion, justified, above all, by the good results achieved.

Talking about the success of Braille music might appear exaggerated, if we consider that the number of people who know Braille music is very low both in absolute terms and in comparison with the total number of blind people. The reasons for this have been extensively described: the complexity of the syntax, the poor quality of scores, the unprepared school teaching, the integration that does not just aim for the study of music by blind people, and others. After all, one might wonder how would be possible to produce so much material for such a small number of users. Therefore, the success of Braille compared to the other formats, is only based on the system's potential in meeting the needs of professional musicians and the ease with which it may be written independently by the blind, both through a Braille typewriter<sup>12</sup> or any Pc text editor.



*Figure 13: Picture of a Braille Typewriter, Perkins model*

As already mentioned above, the most recent technologies have given Braille a new impulse that has created a renewed spread.

---

<sup>12</sup> The Braille Typewriter is a machine used by blind people to write quickly in Braille just utilizing the 6 keys corresponding to the 6 dots of the Braille system.

We believe that the Braille music syntax is the best solution in existence today for blind people to read and write music in an autonomous way, and therefore also the obligatory one, although it is considered complex, scarcely coherent and, as we shall see in later chapters, weighed down by a lack of clear guidelines and rules, the result of compromises in order to arrive at a standard version, recognized by the major countries of the world.

To overcome these difficulties, many have called for the Braille code to be updated in order to make it fully manageable by computer systems.

### **3.4 The International Braille Music Handbook**

In the previous chapter we learned how complex and difficult was the process of standardising the only reading and writing system for the blind, and it is, therefore, not a surprise that the definition and publication of the international Braille music system was only finally achieved in 1997.

A score transcribed into Braille by the end of 19<sup>th</sup> century is somewhat different from that transcribed in the present day, which is mainly due to the evolution of Braille language. Moreover, we must add that there has been an improvement in the syntax of the transcription rules, implemented in different ways by every transcription centre and by music schools in various countries of the world that, in autonomous ways, have developed forms and writing techniques that took into account specific local needs.

Nowadays, in order to exploit the potential of information technology and to meet the requests of users to have an ever increasing number of Braille scores, besides the need to expand the exchange of materials between school, transcription centres and libraries, the urgency of unifying the various "dialects" into a single internationally recognized standard has become more and more pressing.

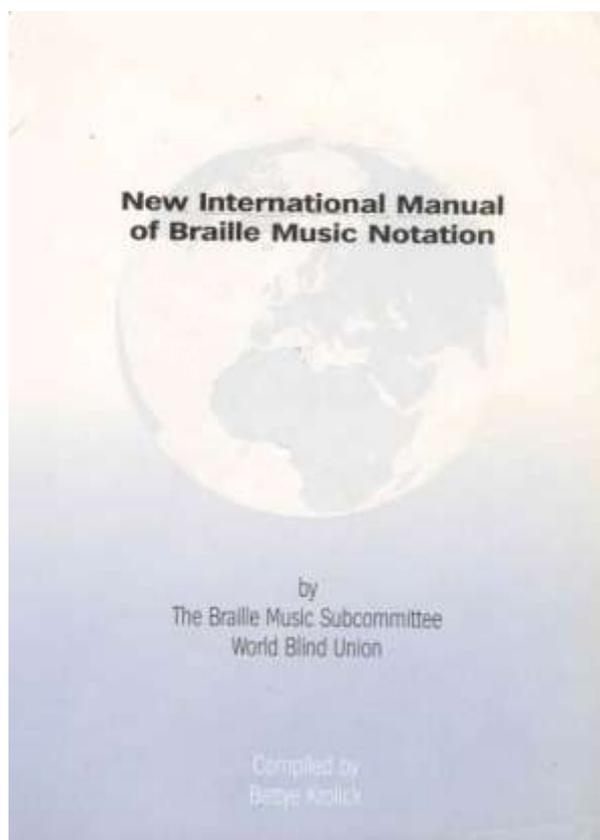
This has happened thanks to the work of "Music World Committee for the Blind" which has worked for almost 50 years towards the creation of the international

Braille music notation handbook.

Here is the introduction to the International Braille Handbook. It describes briefly but clearly, the history that led to the compilation of the manual.

*This New International Manual of Braille Music Notation is the result of many years of consultations within the Subcommittee on Braille Music Notation, World Blind Union (WBU). It is continuing the series of manuals published after the conferences of Cologne, 1888, and Paris, 1929 and 1954. This new manual summarizes the resolutions and decisions of the WBU subcommittee's conferences and workshops held between 1982 and 1994.*

*Unification was reached above all in the following areas: clef signs, figured bass, guitar music, chord symbols, modern music and many other single signs. This manual also contains material of eastern European countries that were not present at the conference of 1954.*



*Figure 14: International handbook cover*

*It benefits in several details from manuals published in Moscow in the seventies and eighties. Important discussions took place at the conferences of Moscow, 1982, (where Dr. Jan Drtina was elected Chairman); Prague, 1985; Marburg (Germany), 1987; and Saanen (Switzerland), 1992. All signs and rules compiled in this manual were adopted by the delegates of the Saanen Conference, mostly by a large majority. Voting delegates to this conference are listed below. We are most grateful that Bettye Krolick was willing to compile the new manual and in the same year sent a first draft to members of the committee. Critical and constructive comments were gathered and presented to the experts in a second draft.*

*This corrected version was unanimously verified and was the basis for the final work. Most all of the delegates contributed suggestions and/or material for the final version. An editorial group consisting of Vera Wessels (Netherlands), David McCann (United Kingdom), Leif Haal (Denmark), and Ulrich Mayer-Uhma (Germany) helped finish the book. But it was Bettye Krolick who did the main work. Thanks to her highly qualified competence, she showed perseverance where the process seemed to stop and conciliation where diverging opinions collided. I want to express my most grateful thank you to her*

*Likewise I thank the SVB in Amsterdam for publishing and distributing the print edition and the SBS in Zurich for printing and distributing the braille edition, giving the blind user the possibility to study the material carefully. We all hope that the signs and rules listed in this book, according to our majority agreements, will be rigorously used in braille music publications. Therefore, we ask the different countries to provide translations into their native language and to use it for future music publications. In cases of doubt, the original English version has the status of major authority. This is the only way to realize the goal of the delegates to improve the exchange of braille music publications between countries. As with most agreements, results could not be reached without compromises. We are aware that some traditional signs of one country or the other were not accepted in the voting. We ask the responsible experts to respect the new decisions, even if they concern signs and rules which are not yet familiar to them. This manual does not*

*include ethnic music from Africa and Asia. The experts of these regions are asked to consider providing signs for the printed music of native instruments not yet covered in braille music. With this manual the work on unification of Braille Music Notation can not be at its end. It will be our future task to reach decisions on formats and specific signs for special cases. We will be grateful for all proposals coming from blind musicians, transcribers and other experts. Meanwhile we wish that the use of this book will be wide spread. We thank all participants of the former conferences for their good cooperation and ask them to join the future work in this field. Subcommittee on Braille Music Notation, WBU, Ulrich Mayer-Uhma, Chairman. Official Delegates to the Saanen Conference Feb. 23-29, 1992 Australia Tom Macmahon Czech Republic Dr. Jan Drtina Denmark Erik Kirbye Finland Paavo Konttajrvi France Louis Ciccone Germany Ulrich Mayer-Uhma Italy Giulio Locatello Japan Toshikazu Kato The Netherlands Vera Wessels North America Bettye Krolick Poland Andrzej Galbarski Russia Gleb A. Smirnov Spain Juan Aller Perez Switzerland Christian Waldvogel United Kingdom David McCann*

As sometimes happens, aspirations are not always sufficient for the realisation of a dream such as that outlined in the Handbook's Introduction. Actually, the hopes of the International Committee are, in our opinion, still far from being realised, and Braille music has a long way to go before it becomes standard for all countries. The correct road, however, has been taken And the internet as well as computer science have pushed hard, like in many other fields, to realise a real common language.

In 2003 an international meeting, organised by the writer, was held in Madrid at the Blind Spanish association ONCE. In this meeting there was wide-ranging discussion about the future of the International Handbook seven years after its publication. The conference was an excellent opportunity to start a discussion on some Braille forms that have not been addressed yet. We refer, in particular, to the problem of the Braille syntax in relation to Gregorian chant and jazz music writ-

ing. Unfortunately, the handbook is still very vague about these genres and even the few passages there are equivocal. This position is partly understandable because the handbook was produced with great difficulty due to the presence of delegates from all over the world, with their own needs and priorities. On the one hand it is important to give due recognition to the handbook, the work of tenacious people like Ms. Bettye Krolick, who truly desired its creation, but on the other a greater international participation is needed, so that the handbook can become more structured, complete and accurate especially in relation to the needs posed by the automatic processing of information. Computers, the internet and long-distance communication need formats to be clear, unambiguous and transportable, even if this requires the sacrifice of abandoning some locally rooted rules and ways of writing. In 2004, the World Blind Union Committee (WBU) held another meeting in Zurich in order to initiate an updating of the handbook, especially with reference to Gregorian music symbols, and a subsequent meeting took place in Leipzig in 2008, focusing attention on issues related to transcription.

## 4. Music and Accessibility

### 4.1 Introduction

It is clear that accessibility should be an integral component of any system, but only recently is this belief beginning to receive the attention it deserves.

In studies, projects and products in which such a component is considered essential, the resulting system will benefit in many ways.

In the systems of production and storage of musical scores (both in printed and digital form) there appears to be interest in the progress of accessibility, but too often this is only lip service. New systems of musical representation must be de-



veloped to allow quicker and easier transcription into accessible formats, although the ever-changing requirements of musical representation tend to slow down the interaction with the available tools. In fact, to any modification of the models used for the representation and syntax of music, one must make an extra effort to synchronize the production in one or more accessible formats. If we were able to incorporate the changing nature of the musical representation in the same model, we would have a means of integrating and incorporating the diverse needs of different representations

for specific uses such as Braille music, Spoken Music and Spoken enlarged printed music. Capturing these aspects in a single model of musical representation that can be used simultaneously for musical production and performance has a particular advantage: it would allow all interested groups to meet their own needs.

With this in mind it is better to focus on the term "accessible music," by which is meant a result that enables a larger number of people to engage in musical activity. This would include people with different levels of skill people with physical and sensory disabilities, and, in particular, blind and visually impaired people.

In order to realise this goal, we adopt strategies such as "design for all" that in the specific musical context obliges researchers to establish guidelines - solutions using new models, guidelines for publishers and for the working groups that promote new standards in technologically innovative sectors, such as electronic archiving, computer transcription and processing and reproduction of sound.

This approach has had some appreciable successes, such as the definition of the "Daisy" specification related to the emerging eBook (or electronic book) technology, and consequently also musical texts. The creation of new accessible music codes based on XML format and the realization of innovative computer products, such as the BME program created by the PLAY2 project, enable a more effective and creative use of music by the visually impaired.

## 4.2 Accessible information

In the field of learning, about 70% of documents required by blind students are in raised Braille format on paper<sup>13</sup> (more or less similar to the original) and many libraries try to offer a service of digitisation on demand.



A key factor in these cases is the speed of delivery. Publishers are often hesitant to provide material in digital formats, since there are few systems of distribution of documents that incorporate digital rights management (DRM) through secure means of communication.

Given the situation described above, notions of "accessibility" are normally equated with the adaptation and conversion of digital content, where this content

---

<sup>13</sup> As reported by the Province of Verona (IT) with reference to its users.

may be available. At both European and national level, current knowledge varies widely concerning the adaptation of digital content for accessibility. Within specific organizations that support blind people, at the university research laboratories and at some transcription centres, several automated tools to perform the necessary adaptation procedures have been designed and implemented. Every automated tool has its own very specific scope and the knowledge required to use these tools differs greatly, so that at present we observe a very low level of exchange or reuse of tools and knowledge from one centre to another. Fortunately, emerging standards at both European and international level provide an excellent basis for the creation of accessible information at a more fundamental level than in the past.

### **4.3 How to make music accessible**

In terms of accessible music encoding, the primary technology during the last century was the raised Braille music on paper, but the growing use of computer to create musical scores opens the doors to new possibilities for addressing the needs of blind people. Some of them have bypassed traditional music notation, and Braille too, and have even become successful performers, creators and music users approaching music from an alternative direction, for example through the recording of song or the use of spoken music. Today we can provide access to musical scores in digital environments and this is an issue that is becoming more and more important as the world of music finally moves towards more wide-ranging agreements and more lasting standardisation in this area.

The issue of accessible music encoding is part of a wider context: the accessible market is a niche market while the various systems are primarily designed for the dominant market. Only after the general requirements have been met are the demands of the secondary users taken into account. In this phase, the solution is very often added as an afterthought and this creates a very poor project environment that does not incorporate the basic principles of "Design For All".

In the field of computing, for example, the basic software in its original form (operating systems, compilers, low-level functions, online digital archives and so on) is usually designed with very robust and modern project methodologies, created for a long duration, but if it were to include extensibility and we asked how it could be adapted beyond the needs of the primary user, then the product may become available to a wider market. The main task of accessible design, therefore, is to encourage this mind-set, with the awareness that exceptional economic benefits could be obtained in the short term. In any case, accessibility should be considered as part of a broader cycle of product development. In music, for example, the range of users of accessible products is really wide and includes blind musicians, music schools, special schools for the blind and visually impaired, specialised transcription centres, music publishers, music content providers and music software developers.

#### **4.4 Accessible music formats**

The accessible music formats available nowadays are: Braille music, spoken or vocal music, tapes or music CDs, MIDI files and enlarged printed music.

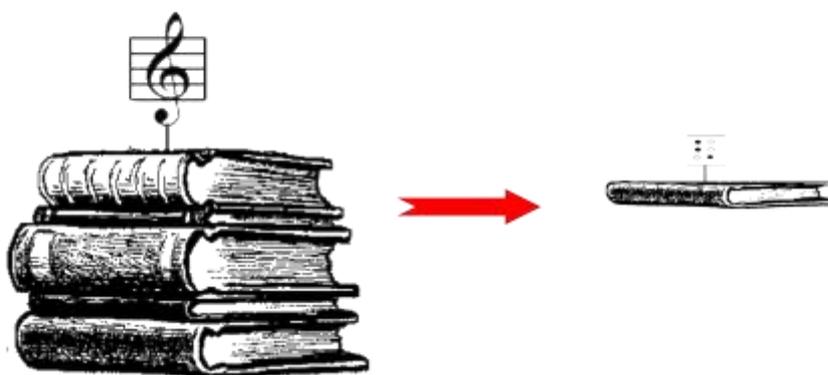
##### **4.4.1 Braille Music**

Braille music is the most widely used accessible format and yet the availability of texts, in terms of quantity and quality, is insufficient if compared to the abundance of available material for sighted musicians.

This is undoubtedly due to the expensive nature of Braille music production. The main factors that affect the current prices of Braille scores are related not so much to the materials used for production and printing, but mainly to the time required for transcription. In addition, the number of qualified people for such work is limited since it depends on many factors: transcribers must not only possess a deep knowledge of printed musical notation, but they also must have a deep knowledge

of the Braille music code.

In almost all cases the Braille music transcription is done manually and at the end of this work the piece must be further proof read with care. In many cases this is done by a second expert.



*Figure 15: Availability of texts in print in comparison with Braille texts*

This process is very laborious and nowadays technology is widely used for the production of Braille music. Here are some of the most popular systems as an alternative to an entirely manual approach:

- Digitization through a scanner using digital recognition and interpretation systems (OMR: Optical Music Recognition <sup>14</sup>);
- Digitization through a MIDI keyboard (playing or using an existing MIDI file) and then translating into Braille code;
- Conversion from a digital format such as Wedelemusic <sup>15</sup>, MusicXML <sup>16</sup> or

---

<sup>14</sup> OMR programs available on the market: Musitek SmartScore, SharpEye Music Reader, VivaldiScan, Capella-scan, PhotoScore, MIDI-Connections SCAN, Gamera, Audiveris Music Scanner, Music Publisher Scanning Edition, PDFtoMusic Pro Music Scanner, PDFtoMusic Music Scanner, Scoremaker, Middle C Software

<sup>15</sup> <http://www.wedelmusic.org/>

<sup>16</sup> <http://www.makemusic.com/musicxml/specification>

others (using programs such as the American Dancing Dots <sup>17</sup>);

- Note by note insertion through a traditional text editor (Wordpad, MSWord)
- Use of a Braille notation editor (Toccata <sup>18</sup>)
- Use of a tactile overlay (like Weasel <sup>19</sup>)

With these tools we can expect a potential reduction in Braille music production costs, because:

- they shorten the transcription time;
- there is less need for highly skilled transcribers;
- thanks to computer support the very expensive paper copies are not needed.

New technologies also offer an answer to another urgent demand from users: the possibility of being able to receive quickly transcriptions that are needed for performances.



*Figure 16: User at the computer reading an electronic document through Braille display*

---

<sup>17</sup> <http://www.dancingdots.com/main/index.htm>

<sup>18</sup> [http://www.pentronics.com.au/index\\_files/Toccata.htm](http://www.pentronics.com.au/index_files/Toccata.htm)

<sup>19</sup> <http://www.cultivate-int.org/issue8/weasel/index.html>

The current Braille transcription methods take a long time. The automation of the processes of transcription significantly reduces the need to check and correct the transcriptions, thereby reducing waiting times.

At the moment the market does not offer a system sufficiently expert and adaptable to all the various instrumental formats, genres and specific needs of users (ease of storage, quick-read Braille form etc.)

#### **4.4.2 Spoken Music**

The term “spoken music” indicates the verbal reproduction of the music text of a score in such a way that it can be easily understood and stored. Moreover, this format should be applicable to all kinds of music written for all instruments. Initially, it might not seem so a difficult task but, on closer inspection, a number of problems arise.

The first problem is related to the verbosity of the format which could produce confusion; the second is related to the more or less extensive possibilities of navigating the text.

The format is, at the moment, quite popular among blind people who didn't have access to Braille scores in the past and therefore did not learn this syntax. It is also suitable for those who have lost their sight as adults and find it very difficult to learn to read raised dotted Braille through touch.

One even more advanced way could be sung music, but there are currently no software products on the market capable of reproducing such a format, in which notes could be described with a voice singing the pitches.

#### **4.4.3 Enlarged Music**

In any survey of accessible formats it is also important to consider the needs of visually impaired musicians. A format that has gained some interest, in this area,

is that of musical notation in large letters. The production of this format can be more complex than a large print (photocopy or published print). Firstly, the degree of enlargement is decided according to the severity of the user's visual impairment and in extreme cases it can happen that the music notation software fails to provide the required enlargement level. Secondly, enlarged printing must always meet the needs of readability in terms of musical phrasing. It is also very important to pay due attention to the clarity of the signs, trying to avoid intersections and overlapping marks, (with reference to music beams, note stems, notes heads a second apart and also in unison). Note stem lengths are reduced and there is some limitation of the additional information around a note or group of notes, on the assumption that reading is done through "snapshots". Lastly, attention is given to the definition of the image which, upon enlargement, may present inaccurate or jagged edges.

Interesting solutions are those that are based on modern vectorial platforms such as SVG (Scalable Vector Graphics), in which the graphic description is based on signs, lines, and vector fonts and therefore the representation may (at least in theory) be increased in size to any level.

Some organizations, like the English RNIB<sup>20</sup> produce music in enlarged characters using existing commercial music publishing software programs such as Sibelius<sup>21</sup> Their work is not simply limited to an enlargement of the page, since this would tend to produce a score that was difficult for a visually impaired person to read. In the printed version of enlarged letter scores, the software extends the staff within the standard size of the page, for example, turning a piece with 6-8 bars per line, into one with 1-2 bars per line. The electronic copy can also be updated time after time in response to the requests and individual needs of users.

---

<sup>20</sup>See the RNIB website dedicated to enlarged music:

[www.rnib.org.uk/livingwithsightloss/leisureculture/music/readingmusic/Pages/modstave.aspx](http://www.rnib.org.uk/livingwithsightloss/leisureculture/music/readingmusic/Pages/modstave.aspx)

<sup>21</sup> <http://www.sibelius.com/>

## 5. Information technology in support of visual impairment

### 5.1 The Braille system and information technology revolution

The great technological developments in our society are leading to significantly greater autonomy for the visually impaired, whether partially sighted or totally blind.

It is important to observe (see an article by Dr. Paolo Graziani<sup>22</sup>) that we still are far from a "global" prosthesis, that is a technical device capable of replacing sight in all its many and complex functions. We must be content, therefore, with devices and aids aimed at individual aspects of autonomy for blind and visually impaired people.

The recent "MIT Fifth Sense project" proposal funded by the Andrea Bocelli foundation aims to overcome these limitations, but we are still at an early stage of this project and at the moment there are no concrete results to be assessed.

Traditionally, two major classes of problem are considered: those of environmental orientation and those of communication, particularly concerning access to information and culture.

For the first type of problem technological devices are impractical, and so the white stick and the guide dog remain the aids of choice. This is the case despite current experiments in urban planning that use tactile routes - tracks with raised

---

<sup>22</sup> Paolo Graziani, now retired, was a researcher at the CNR - IROE "Nello Carrara" in Florence (IT), and was the creator of the Italbra program. He has also developed the first speech synthesis in Italian.

lines on the pavement for blind and visually impaired people. With respect to the second type of problem considerable progress has been made.

As already explained, thanks to Louis Braille, blind people are able to use an efficient method of tactile reading and writing that gives them the opportunity to study as well as social and cultural freedom.

The earliest forms of technical communication aids were tablets and punches, then followed by Braille typewriters (usually known as Braillers).

More recently, technological development has indirectly provided other types of assistance (radio, telephone, typewriter, tape recorder) that, even if not designed as typhlotechnical tools, have become remarkably important to blind people for solving the problems of communication and access to information.

In the early 70's the development of Optacon<sup>23</sup> (Optical to Tactile Converter) aroused considerable hopes that the barrier of printed-paper could be overcome; these expectations, however, were partly disappointed, even though it is a specific reading aid offering blind people a limited but genuine autonomy.

For the visually impaired, magnification on television screens has significantly increased the ability to read independently even with only residual vision.

Today many aids exist in portable versions, thanks to new technologies that allow the use of miniature cameras, flat and light liquid crystal screens

---

<sup>23</sup> The Optacon is constituted by a tiny camera positioned, with one hand, on a text to capture a small portion of the image, as a character. This information is reproduced on a matrix of needles where the forefinger of the other hand is put. Through the sense of touch it is possible to decipher the image or text.



*Figure 17: Optacon (source: <http://en.wikipedia.org/wiki/Optacon>)*

The development and the dissemination of information technology are therefore changing the nature of the problem of communication for blind people.

Information in coded form is, in fact, much more adaptable than printed paper to presentation in alternative forms. This is achieved through software that intercepts visual information and converts it to non-visual outputs such as a Braille display or speech synthesis. Information presented by a Braille display is described as "labile", due to its being erasable, since it is made up of dots that rise and fall under electronic control.



*Figure 18: Braille Display (source: [www.braillet.net.org](http://www.braillet.net.org))*

A suitable display management program can serve as an interface between the operating system, the display itself and the input / output peripherals, allowing the use of normal applications, (e.g. for word processing, database management etc.), indeed, any program that presents textual information, the only exception being those that deal solely in graphic information.

For the visually impaired, the alternative display may be on the screen itself, not used in the conventional way but, using an interface program that magnifies characters and icons. In addition, speech synthesizers may be utilised in combination with the magnification software.

In some cases it is also possible to integrate the use of a camera, in addition to whichever system of screen access is being used, in order to achieve the best combination of reading printed matter and access to the computer itself.

Among the possible uses of a PC adapted for the blind or visually impaired is that of writing using word processing software. This is undoubtedly a resource of general interest, as the problem of information access affects all users, regardless of their level, their type of study or professional activity. It may be noted that the opportunity provided by such programs, of checking and correcting a text, is a true leap in quality (compared with using a normal typewriter) for a blind person.

Another relevant computer application is one designed for the direct reading of printed paper through OCR (optical character recognition) systems. These applications were developed for automating office tasks or to facilitate the reprinting of old books. The scanner scans the printed page, which is then interpreted by OCR and saved in a text management program (for example, "Microsoft Word").

Once the text has been acquired and saved to the PC memory it may be read by a synthetic voice or a Braille (or bar) display. Alternatively it can be interpreted by a program that can translate the characters into Braille. The text may then be output in both print and embossed Braille.

Besides the direct use by the blind people, OCR systems may be usefully employed to facilitate the transcription of books and documents into Braille,

although this is limited to texts that do not give rise to particular difficulties in automatic reading. Some texts, including some school text books, are not suitable for computerised reading due to the numerous types of characters, text boxes, marginalia, colours, shapes, etc. These require interpretation for an effective Braille edition and not just a simple transcription of all the words on the page.

It should not be forgotten that methodologies have existed for many years for producing raised images and drawings for blind people using semi-automated procedures. In practice, the original drawing, which must conform to certain criteria of clarity and simplicity, is photocopied onto a special chemical paper, known as "swell paper", the sheet is passed through a machine equipped with an ultraviolet lamp. Swell paper has a special coating of heat reactive chemicals. Microcapsules of alcohol implanted in the paper fracture when exposed to heat and make the surface of the paper inflate. Placing black ink on the paper prior to a heat process provides control over the raised surface areas. The result is a black and white raised copy of the drawing, which retains some features of the original, such as the line thickness and the pattern of the background<sup>24</sup>. This technique which is quite costly (albeit sustainable), may be very useful, if properly used, for the learning of the conventional musical notation by blind students. In the early stages, this technique can be used to transcribe simple scores in raised writing, provided it meets the typical criteria of haptic exploration, as reported by Revesz<sup>25</sup>. In this context it is worthwhile mentioning that raised replicas of works of art and monuments drawn to scale have been created on plastic pages. Other methods use special pens created for raised writing particularly on fabrics.

---

<sup>24</sup> See *"Immagini da toccare" Monza Library edition*

<sup>25</sup> Révész G. *La psicologia dell'arte dei ciechi*, Roma, Istituto Augusto Romagnoli.

## 5.2 Reading print compared with tactile and speech synthetic solutions

If the first great revolution was that of Louis Braille, which solved the limitation of access to culture through its writing system, a second transformation has taken place thanks to computers and the introduction of Braille displays and screen readers.

Thanks to Louis Braille, blind people, who until then did not have an appropriate medium for reading and writing, and were thus confined to an oral culture, for the first time in history had the opportunity to gain full access to culture and to become cultural producers themselves.

The introduction of computers and screen reading programs with speech output characterised the second revolution that does not, of course, negate the first, but indeed expands its possibilities. Braille is, in fact, additional to the speech synthesis, expanding the access to culture and written information, and providing new work opportunities for blind people.

In brief, what are the main differences between traditional reading of printed materials and the reading techniques used by the blind, namely Braille and / or speech synthesis?

Certainly reading Braille is the closest form to visual reading, but it has some disadvantages also, partly understandable by comparison with reading via a synthesized voice. Braille reading allows you to perform all the typical operations of visual reading: browsing pages, skipping passages, reading silently or aloud, understanding the general structure of the text or going down to the smallest details, forming a mental map of the words that have been read and, last but not least, placing the written information in the physical space, which then becomes an imaginative space.

The disadvantages, certainly worthy of note too, concern the slowness of reading, the cumbersome nature of Braille books, the high costs and the difficulty in finding them.

Speech synthesis, on the other hand, allows fast listening, but does not facilitate the placing of information in just one space. Moreover, it does not always make the spelling clear or the punctuation, and makes the reading of tables more complicated. The actions of hearing and listening help with the recall of written symbols for those who can read and write in Braille. For those, however, who have deficiencies in Braille literacy, the only form of knowledge available to them, the oral, unfortunately limits the possibilities of learning and formulation of concepts. It leaves only labile traces in the memory that cannot easily be updated, corrected and enriched through a continuous, flexible and personal reference to a written source. This proves to be a very important obstacle to authentic education and so denies the principle of equal opportunities.

In our opinion, an optimal solution is the ability to have both and properly to use reading Braille tools, as well as those instruments that allow reading via speech synthesis. For example, a list, a paraphrase, a mathematical text, a foreign language text or simply a very rich text - all of these are better suited to tactile reading, while a well-known text, whose reading is fluent and does not have too many references, can be listened to and possibly established in the memory by taking a few notes.

In recent years there have been signs of a return to serious illiteracy - and not just in music - due to the fact that the basic new technologies (iPads, smartphones, and similar technologies just based on listening), have driven blind people away from the Braille system, offering them, from childhood, an easier and more immediate alternative, the speech synthesis system as their main access to information. In this the internet is a great ally because online one can so easily obtain a great deal of information in text format, ranging from newspapers to works of fiction.

All of these options must be carefully evaluated in order to understand better the way in which technology is changing the nature of some disabilities. If, on the one hand, it helps in overcoming difficulties, on the other it involves the risk of introducing new cultural barriers. Over the past 150 years, the Braille system has made possible the creation of a great number of books offering the same functions as

conventional texts. Texts in electronic format, more dynamic and navigable than printed ones, can be read both by touch through Braille displays and through speech synthesis, an element that, as we already said, offers a new means of reading, a less tiring alternative to Braille.

In the United States they tend to prefer speech synthesis to tactile reading, much more than in Europe. In fact, in the United States Braille has now been more or less abandoned by the younger generation as stated in the 2008 *New York Times* article of reporter Rachel Aviv (published on January 30, 2009)<sup>26</sup>. This article states that a National Blind American Federation study shows that less than 10% of blind Americans can read Braille.

The same author warns that the study must be interpreted carefully. There is a margin of error due to differing attitudes as to the usefulness or not of Braille for the visually impaired, even those with serious impairment, or for those who have multiple disabilities. Despite these limits, the data are very significant, especially if compared with a similar study made in the Fifties in the same country, from which it emerged that 50% of blind people were Braille users.

The research that will be carried out by the project MUS4VIP intends to overcome the problem described above by adequately exploiting the available resources, both in terms of use of the senses (touch and hearing) and adaptation of existing technology that combines optimally the use of these two sensory channels.

With respect to the world of music writing, the research work of the author aims to get the best possible benefits from the sense of touch, as a valid means for real literacy, and the sense of hearing, which allows a faster and more flexible "vision" than that of a musical score, but does not allow the same flexibility in the examination of detail. With regard to the technologies, the research aims to ensure a synergy between the use of tactile devices such as Braille displays and embossed Braille, as well as devices and solutions based on hearing, for example, computer sound cards, midi data, speech synthesis (and therefore the use of spoken word).

---

<sup>26</sup> [http://www.nytimes.com/2010/01/03/magazine/03Braille-t.html?pagewanted=all&\\_r=0](http://www.nytimes.com/2010/01/03/magazine/03Braille-t.html?pagewanted=all&_r=0)

The goal is to promote Braille music literacy, using hearing and touch to support and complement each other in the complex process of deciphering and understanding music as a formalized language and a cultural phenomenon in different historical contexts.



## 6. Braille music, analysis of peculiarities and problems

### 6.1 The model for representation

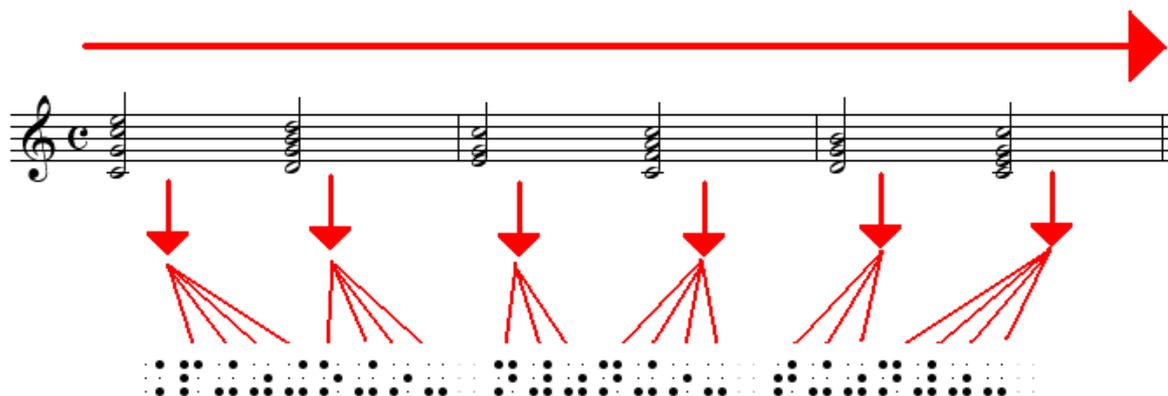
The traditional western music notation (referred to here as printed music or black and white, to distinguish it from raised Braille writing) has a two-dimensional graphical representation (with signs vertically and horizontally arranged), in which the piece of music is presented as a set of staves on which notes in succession are described both horizontally (melody, dynamics, lyrics) and vertically (harmony, accents, ornaments).



Figure 19: Example of graphical music representation on a staff

Writing Braille music has, instead, to follow some linear and sequential criteria of representation, except for those transcribed "bar on bar" songs, a technique not always used anyway. This means that accents, fingering, chords and polyphonic and polyrhythmic phases, are represented in Braille by placing symbols one after the other on successive lines, so losing the vision of the temporal correlation between the parts. Braille music notation has rules that are designed to avoid ambiguities

and misunderstandings in the interpretation of the basic signs, as mentioned in the second part of this work.



*Figure 20: Correspondence between traditional notation and a Braille score*

It is also worth mentioning that Braille writing allows music to be represented in more than one way, and this means that the same bar might be given in two or three different representations. The particular representation chosen might relate to educational objectives or to other external factors such as the need to save space and paper.

## 6.2 Evolution of Braille music notation

Over the course of the last century, the Braille music code has evolved continuously, mainly due to the constant search for new educational solutions by transcribers and teachers, aimed at a more and more accurate description of the original score and ease of reading and storage. A significant driver that led the world blind committee to the publication of the New International Handbook was the need to be able to use information technology to manage and store Braille music in electronic format. In today's world, blind musicians would like to get paper or electronic texts not only from their own national library, but they would also like the chance to

consult world library catalogues published on the internet, using new forms of distribution and e-commerce.

Printed music (with the exception of modern notation and Jazz signs) has been largely standardised at an international level for a long time, Braille music, on the other hand, has undergone a continuous process of transformation due to the fact that one of the objectives pursued in Braille writing is to produce texts that are both as concise and as clear as possible, whilst achieving the maximum precision and fidelity to the original. This can be explained by considering the following factors:

- the need to reduce paper usage.
- the need to reduce copying time. Braille writing, before the beginning of computer science, was performed manually both using slate and stylus (thus writing a dot at a time) or using machines (e.g. Perkins Brailleurs), based on the combined use of 6 keys (corresponding to the 6 dots of a Braille cell), which made writing faster, allowing the writing of a character at a time.
- the need to reduce reading time. Since Braille is read through the fingers, this reading is far slower than visual reading and so it is useful to reduce the reading time by concentrating the maximum amount of information in the minimum possible number of characters. Hence there are various devices to represent typical patterns (progressions, alternating octaves, etc.).
- the need to memorize the piece of music. To study a passage, a blind musician has first to read the score, section by section, and then memorizing it step by step. If the transcriber is able to identify in the composition some musical patterns or some passages that are repeated several times, he will pass this information on to the musician in order to help him/her in understanding the structure of the piece and memorise it more easily. To explain this properly, look at the example below. In the Braille version this does not necessarily have to be written out in full.



Figure 21: Example with repetitive musical fragments

For the left hand it is sufficient to write the first bar and then include a particular symbol indicating that this bar has to be repeated three times.

This means that less text need be written, which saves reading time, and also helps the musician to create a mnemonic scheme of the musical passage.

### 6.3 The Braille music notation

Braille music notation provides a linear description of music, by using only the 63 Braille signs. Here are the signs in their normal arrangement of 7 lines of 10 characters each with the exception of the last two.

#### Diagram of the 63 Braille characters

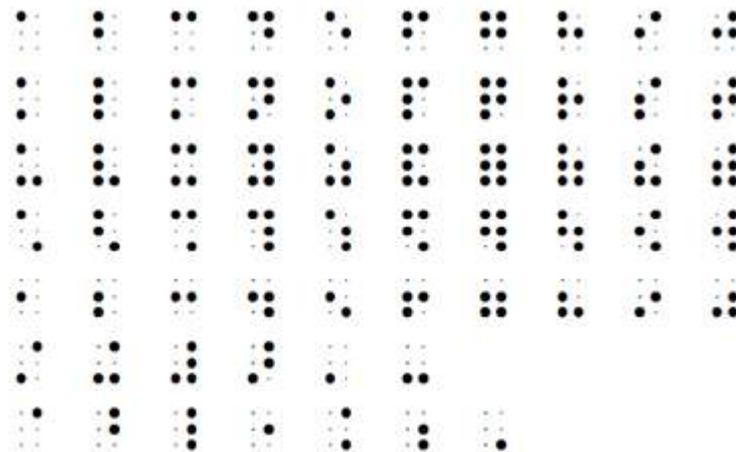


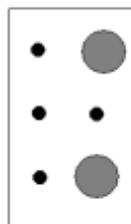
Figure 22: The 63 Braille signs arranged in their normal 7 lines

The first 25 characters of the above table correspond to the 25 letters of the French alphabet. All other symbols such as accented vowels, punctuation, etc. have a corresponding sign that depends on the language, since each country uses individual and autonomous Braille signs to represent them. This highlights the problem with the interpretation of texts in different languages, and in computing this means having to consider different assignments and correspondences between the characters of the ASCII table and the 6 dots Braille symbols. This is not unimportant as it precludes the exchange of electronic Braille texts between different countries. Although the problem is less severe with a text (since the 26 letters signs are common to all countries and with a little common sense one can understand a text completely even if it contains accents), it becomes significant for writing music (and also in mathematics).

In order to be able to disseminate their musical texts, FNB (the Braille Dutch Library) has attempted to overcome the problem by producing dozens of ASCII conversion tables for the main European languages, but problems still remain. For example, print characters that require two or more Braille signs may only be identified with reference to the context.

Given that the number of Braille characters relatively small, in comparison with printed musical signs, it is evident that a blind musician is forced to use them in a compound form, joining two or more signs and giving this composite symbol a single notational meaning. From this it is also clear that some signs, taken individually, acquire different meanings dependent upon their position in the musical context. This makes the writing of Braille music particularly complex.

For example, symbol 61 (in the above table), constituted by dots 4 & 6



can change meanings depending on the context and on the characters that follow it, so it would make no sense to consider it in isolation:



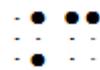
Capital letter A or "octatonic demisemiquavers" (*Sixty-fourth notes in American English*)



Capital letter D or "octave 5 symbol before a C quaver (eighth note)"



Alteration in 64ths



Tie for a chord



Measure-division for In-accords



Prefix for right hand in a piano score

Braille writing, besides representing all the symbols used in print, has had to develop new and specific ones to represent the two-dimensional elements of music, such as chords, voices, parts. When sighted people browse a score they run their eyes horizontally from left to right, but at the same time they can comprehend information presented in the vertical direction too, for example recognising symbols written above or below a voice.

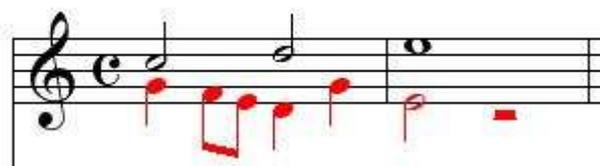
In the Braille system, however, the blind musician is obliged to read horizontally, so that the vertical information must be described sequentially.

For example, the representation of multiple voices is done using the "In-accord" sign, a symbol that does not exist in print. This symbol indicates to the reader that the following notes belong to another voice within the same bar.

There are two types of In-accord sign, the full In-accord and the partial In-accord.

The full In-accord indicates that the subsequent notes belong to another voice within the same bar, and that they start from the beginning of the bar.

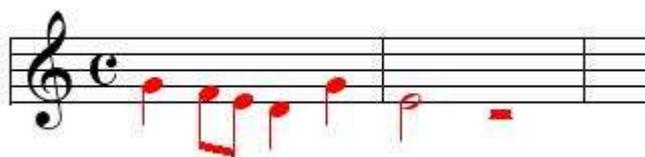
Full In-accord



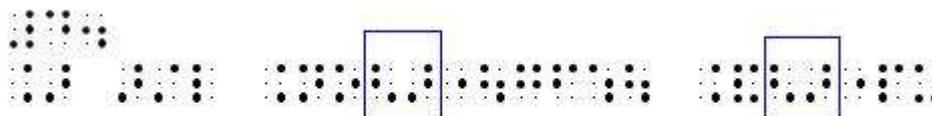
First voice



Second voice



Corresponding Braille version



#### 6.4 Analysis of the use of contractions in Braille music

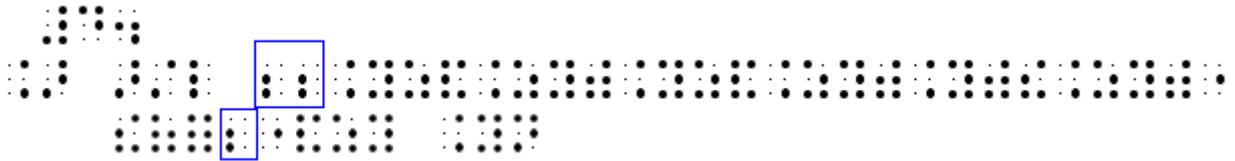
A further aspect peculiar to Braille music is the use of special symbols used to contract the text, similar to the print signs for repetition of whole or partial lines.

Another means of contraction is the indication of some repetitive aspect of the music. In this instance the symbol for this aspect of the music is placed in double form at the beginning of the sequence and in single form at its end.

Here is an example:



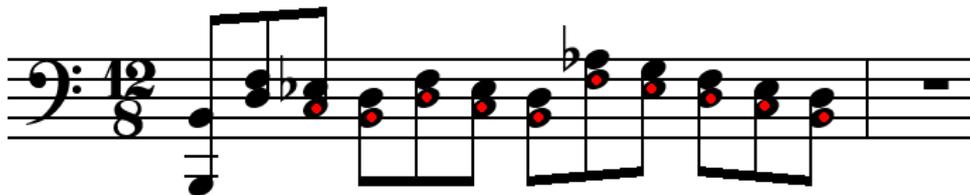
Corresponding Braille version. The fact that all the semiquaver (16th note) groups are triplets is indicated by the triplet sign being written twice at the beginning of the passage and once at the end of passage.



Here are some more examples, taken from the 12 Characteristic Studies by Moscheles, in which may be seen some typical Braille situations.

**1) Chords and major third intervals**

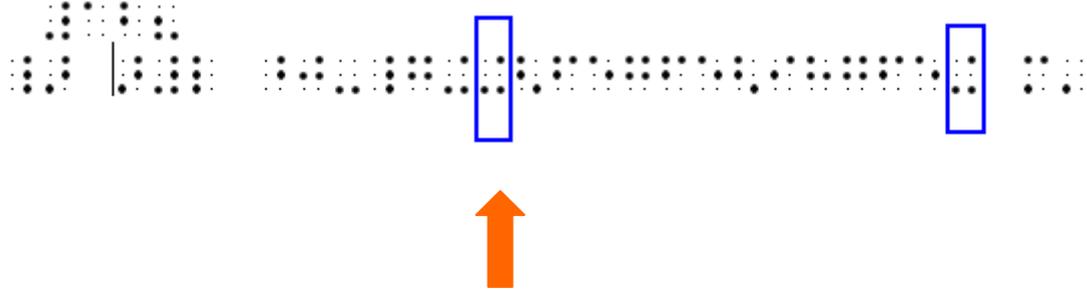
In this example it can be seen how there is a sequence of third intervals. It is possible to transcribe this passage into Braille in the following two ways:



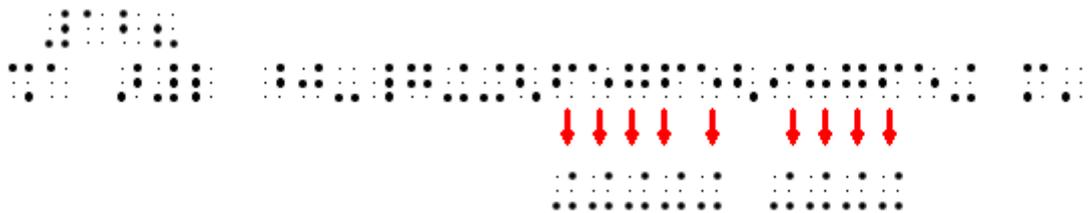
**Example 1: first mode**



In the example 1, we can see how a second sign follows each note - the sign for a third harmonic interval (  $\begin{smallmatrix} \cdot \\ \cdot \\ \cdot \end{smallmatrix}$  ). This type of writing is not very practical because the user is forced to read the same symbol (that of a descending third interval) over and over again. The alternative is to represent the same passage as in Example 2, doubling the third symbol at the beginning of the sequence.

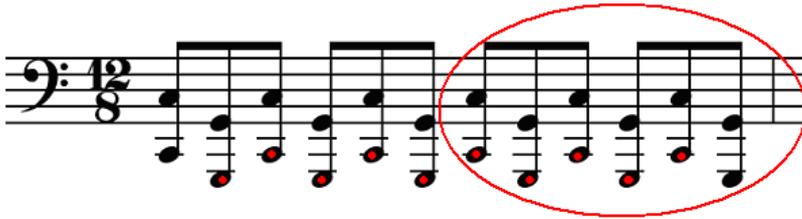
**Example 2: contracted representation:**

Here sign for a third interval has been doubled after the second quaver (eighth note) while all other interval signs have been deleted, apart from the final one. This indicates to the musician that all the notes from the second quaver (eighth note) onwards must be doubled at an interval of a third. In effect, the interval signs are hidden, as shown in Example 3.

**Example 3:**

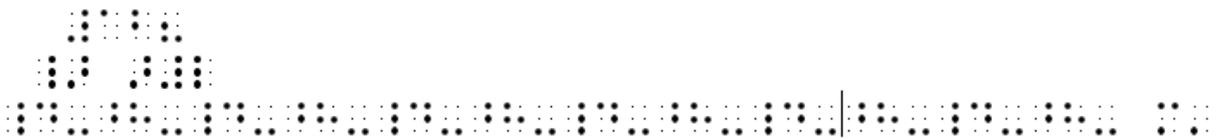
## 2) Repeated octaves

The example below shows a line containing a number of octaves. Note that the second half of the bar is identical to the first.



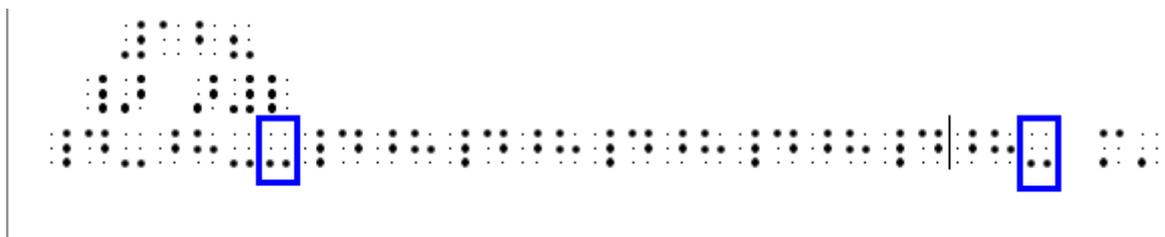
This example can be represented in Braille in the following ways:

a)



In this case there is nothing special: each note is accompanied by its octave interval.

b)

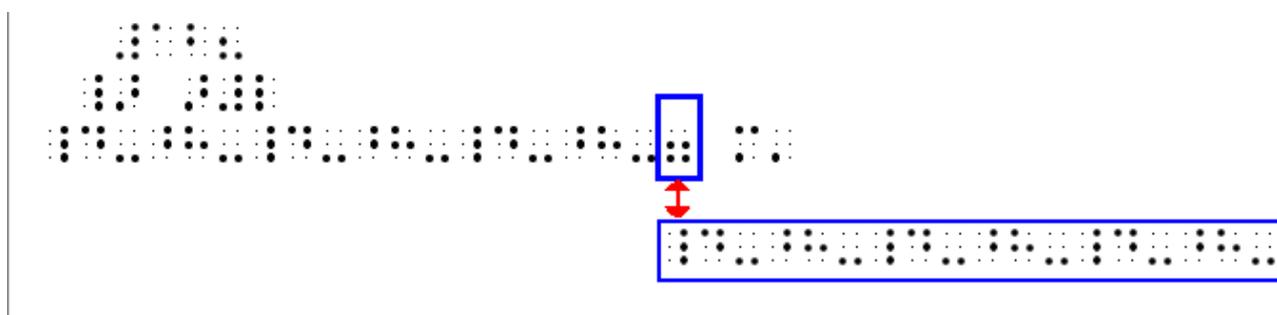


In the example **b** the first octave sign was doubled. The notes following the first

chord must therefore contain an octave interval. Note how the number of Braille characters has been reduced from 48 (example **a**) to 40 (example **b**).

Since the second part of the bar is identical to the first one, it is possible to contract it further as shown in example **c**.

c)



In this case the repetition sign (the character with dots 2,3,5,6) contains information relating to the second part of the bar. Note that with this representation, Braille characters have been further reduced to 28.

From the above examples it is clear how flexible the Braille music system is. According to the characteristics of the original text and to the objectives that the transcriber wants to achieve, it can take different forms and modes of representation.

If a song is intended for a beginner, it will be better to adopt an uncontracted form, while if the piece is intended for experienced users the writing will be contracted as much as possible.

Further examples of the use of contractions are given in section 6.13.

## 6.5 Analysis of difficulties in transcription from printed music to Braille music

Given below are some examples of the linear transformation of printed music writing into Braille.

A simple barline is represented by a blank character or space.

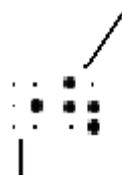
The most common case of two-dimensional representation to be converted into linear format is that related to the musical figure on the staff, since according to its location it indicates the name of the note and the pitch, as well as representing the length of the note.



*Pitch / Duration*

In the Braille system, musicians are first informed of the octave in which the note is placed and subsequently, with just one symbol, they are informed of the name of the note (to be placed in the octave specified) and of its duration based on the classification of traditional music symbols.

Note name



Octave number

Furthermore, the blind musician receives the correct information concerning the duration only after having read the entire measure. In fact, in Braille music every note can represent two different musical durations. Which value applies will depend

upon the time signature and the number and total values of notes included in the measure.

This aggregation model of the linear representation of Braille music is found in many other notational contexts (vocals, chords, parts, singing, etc.).

In the following chapters we will discuss some of the main solutions used for proper transcription from printed music to linear Braille, taking into account the fact that there are many exceptions and numerous special instructions related to each musical instrument. This is another reason why some Braille signs acquire new meanings depending on the context.

## 6.6 Notating parts

The information relating to parts is a characteristic and necessary element of Braille music, although it has no exact equivalent in print.

A piano score is translated into Braille by indicating two part symbols:

For the right hand the symbol is the following:

⠠⠠⠠

For the left hand the symbol is the following:

⠠⠠⠠

This can also be indicated in different languages. So, in Italy, one can find the following symbol for the right hand:

⠠⠠⠠

(These are the literary Braille letters "md" which stand for "right hand", "*mano destra*" in Italian)

It can also occur with the following variants (m.d "m" separator dot and "d")



or (m.d.)



While in France the right hand can be written like this:



("md" means "main droite")



And the left hand (main gauche = mg)

In Braille, notes that belong to the right hand are described first, followed then by those of the left hand, for a variable number of bars. Usually when translating from printed music to Braille it is necessary to translate all the bars in each line alternating between right and left.

This example describes the first four bars of the right hand (highlighted in yellow), then the first four of the left (highlighted in red):

The figure illustrates the correspondence between traditional musical notation and Braille notation for a piano piece. The top part shows a musical score for piano in 2/4 time, starting with a treble clef and a key signature of one flat. The score includes a first measure marked '1', a 'cresc.' instruction, and several measures with dynamic markings like 'V.'. The bottom part shows the corresponding Braille notation, with a grey header bar, a yellow body for the right hand, and a red body for the left hand.

Figure 23: Correspondence between traditional notation and Braille in a piano piece

If the transcription were to continue the sign for the right hand would appear again for each line until the end of the piece.

In addition to the part symbols for right hand and left hand there are symbols for the orchestral instruments. So, a piece for violin will have as part indication the word "violin"



(violin)

There are, however, also many scores for solo instrument in which the name is omitted because it is assumed that the performer knows how to locate the starting point of the score.

In an orchestral piece the full name of the instrument is written the first time it appears, while for subsequent times only an abbreviation is inserted. So, the first time the flutes will be described by the name "flutes"

“flauti (flutes)”

while the subsequent lines will be simply marked with the abbreviation "fl"

“fl”

## 6.7 Key signatures

In Braille music, as well as in print, tonality is indicated by the use of key signatures. For key signatures of up to 3 sharps or flats they are written using the corresponding number of sharp or flat symbols placed one after the other

1 flat 

2 flat 

3 flat 

If the key signature contains more than three sharps or flats it is necessary to insert the "number sign" symbol followed by the number and appropriate sharp or flat sign. In this way a key signature never takes up more than three Braille cells.

4 flat  (number sign, number 4, flat sign)

5 flat 

6 flat 

7 flat 

So, the following example with 5 sharp symbols:



is translated by:



Please note that in Braille music the pitches of the sharps or flats in a key signature are not indicated, only their number.

In more complex cases, such as a change of key signature it is necessary to cancel the old key signature with naturals before giving the new key signature. Here, for example, is a transition from a 4 sharp key to a 5 flat key:



is translated by:



The key signature (indication of tonality) is always located before the time signature, as in printed music. A space is sometimes left between the two.

The key signature usually appears before the right-hand score part and it is not necessary to repeat it for the left-hand part, as is the case printed music. There may, however, be some pieces of modern music in which the two score parts are in different keys and in this case the key signature must, obviously, be given for both parts.

The above rules also apply to changes of key during the course of a piece, as even in this instance it is sufficient to indicate the key change in the right-hand score part only. There is no need to repeat it for the left-hand part except in the case, mentioned above, of the parts having different key signatures.

## 6.8 Time signatures

The time signature indication is positioned before the score part and after the key signature, if present. There are several ways to denote time. Here are some examples:



*Number sign, number 3 plus lower 4*

The same example can also be written with a lower numerator and upper denominator



*Number sign, lower 3 plus 4*

The same applies with two figures in the time signature:



or



The typical time signature  $\frac{4}{4}$  can be represented in different ways, as shown below:



upper numerator, lower denominator;

lower numerator, upper denominator;

numerator only

top number, dot 3 of separation C quarter note sign THIS IS MISSING

Capital letter sign followed by "C" for Common time ( $\frac{4}{4}$ )

## 6.9 Pitch and duration of notes

The pitch and duration of Braille notes are described by two symbols: the first indicates the octave in which the note is, the second the name of the note and its duration. So, the following example will be translated like this:





The first symbol indicates that the note is in the fourth octave. The second indicates that it is a B minim.

If the note following the B forms an ascending or descending interval of a second or a third, there is no need to use any octave symbol.

If the note following the B forms an ascending or descending interval of fourth or fifth, an octave sign must be used if the next note is in a different octave, as in the following example



In the next example the A (a fourth interval above the E) does not require the octave sign because it is in the same octave.



The octave sign must always be repeated after:

- A change in voice
- A change of the score
- An expression in literary Braille

Here are the octave signs, in each case followed by a C crotchet:

First octave: 

Second octave: 

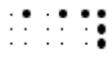
Third octave: 

Fourth octave: 

Fifth octave: 

Sixth octave: 

Seventh octave: 

Double low octave: 

Double high octave: 

Note that double octave symbols can be used, albeit rarely. The lowest three notes and the top C on the piano would require double octave signs.

Below is an example of the use of octave symbols

The image shows a musical staff with a treble clef and a common time signature (C). The melody consists of the following notes: C4 (quarter), D4 (quarter), E4 (quarter), F4 (quarter), G4 (quarter), A4 (quarter), B4 (quarter), and C5 (quarter). Below the staff is the corresponding Braille notation. The first note (C4) is represented by a Braille note with a double octave sign (dots 1-2-3-4-5-6) and a C-clef (dots 1-2-3-4-5-6). The subsequent notes (D4 through C5) are represented by Braille notes with single octave signs (dots 1-2-3-4-5-6) and their respective pitch classes (D, E, F, G, A, B, C).

The durations of Braille notes are as follows:

Quaver (Eighth note) or  $\frac{1}{128}$

C    D    E    F    G    A    B

⠠⠠⠠⠠⠠⠠⠠    ⠠⠠⠠⠠⠠⠠⠠    ⠠⠠⠠⠠⠠⠠⠠    ⠠⠠⠠⠠⠠⠠⠠    ⠠⠠⠠⠠⠠⠠⠠    ⠠⠠⠠⠠⠠⠠⠠    ⠠⠠⠠⠠⠠⠠⠠

Crotchet (Quarter note) or  $\frac{1}{64}$

C    D    E    F    G    A    B

⠠⠠⠠⠠⠠⠠⠠    ⠠⠠⠠⠠⠠⠠⠠    ⠠⠠⠠⠠⠠⠠⠠    ⠠⠠⠠⠠⠠⠠⠠    ⠠⠠⠠⠠⠠⠠⠠    ⠠⠠⠠⠠⠠⠠⠠    ⠠⠠⠠⠠⠠⠠⠠

Minim (Half note) or  $\frac{1}{32}$

C	D	E	F	G	A	B
⠠	⠠	⠠	⠠	⠠	⠠	⠠

Semibreve (Whole note) or  $\frac{1}{16}$

C	D	E	F	G	A	B
⠠	⠠	⠠	⠠	⠠	⠠	⠠

From these examples we learn that every Braille musical note can have two different durations. To identify the correct duration, one has to read the entire measure. The duration is then clear from the context.

Note C  $\dot{\cdot}$  may have the duration  $\frac{1}{4}$  or  $\frac{1}{64}$ ;

Note C  $\ddot{\cdot}$  may have the duration a whole or  $\frac{1}{16}$ ;

Note C  $\ddot{\cdot}$  may have the duration  $\frac{2}{4}$  or  $\frac{1}{32}$ ; should read 1/2

Note C  $\ddot{\cdot}$  may have the duration  $\frac{1}{8}$  or  $\frac{1}{128}$ ;

Here is an example with all the durations:



Note that in this Braille translation the musical beams were not taken into account. In practice it is necessary to translate this aspect of the printed music since it makes tactile reading faster.

Here is the same example as above, taking account of the beams:

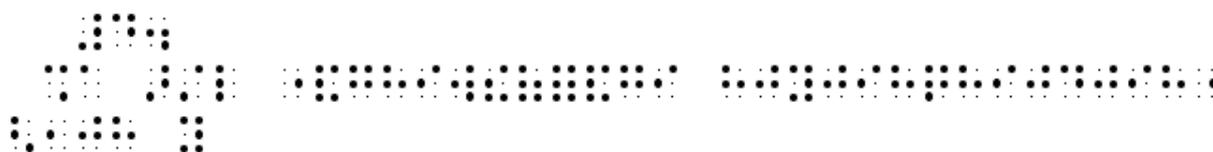


When notes are united by a beam, only the first of the group is represented with its real value, while all following ones are represented by a quaver ( $\frac{1}{8}$ ) figure.

Here is another example:



Translation into Braille



In some cases the context is not enough to understand the duration of a note, because the same symbol can represent two values, as indicated in the above table. Sometimes you need to add some explanatory symbols that clarify whether the next note should be of greater or lesser duration:



If the distinction symbol were not inserted, the musician might confuse the notes with a series of beamed sixteenth notes.

The value distinction symbols are the following:

Choose the bigger value



Choose the smaller value

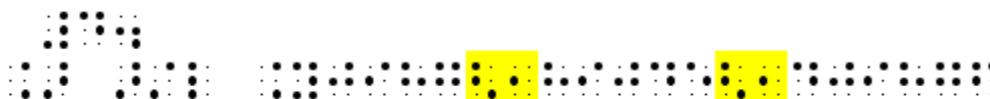


There is another symbol that indicates the interruption of a rhythmic group:



This sign indicates to the musician the rhythmic separation between notes of the same duration, which the composer wanted to emphasize to indicate a particular rhythmic grouping.

For example:





Example

The image shows a musical staff with a treble clef and a common time signature. The melody consists of several measures. The first measure contains a triplet of eighth notes, indicated by a '3' below. The second measure contains a quintuplet of eighth notes, indicated by a '5' below. The third measure contains a decuplet of eighth notes, indicated by a '10' above. The melody ends with a quarter note and a half note. Below the staff is a Braille representation of the same melody. The Braille notation uses a 6-dot system where the first three dots represent pitch and the last three dots represent rhythm. Red dots indicate specific rhythmic values: a triplet of eighth notes (dots 1, 2, 3, 4, 5, 6), a quintuplet of eighth notes (dots 1, 2, 3, 4, 5, 6), a decuplet of eighth notes (dots 1, 2, 3, 4, 5, 6, 7, 8, 9, 10), a quarter note (dots 1, 2, 3, 4), and a half note (dots 1, 2, 3, 4, 5, 6).

## 6.10 Rests

In the Braille music system, rests are represented in the following way:

A quaver (eighth note) or  $\frac{1}{128}$

⠠⠠

A crotchet (quarter note) or  $\frac{1}{64}$

⠠⠠⠠

A minim (half note) or a  $\frac{1}{32}$

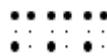
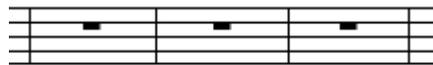


A semibreve (whole note) or  $\frac{1}{16}$



In order to reduce the number of characters, in the case of two or more consecutive bar rests, the contracted form may be used.

For example, a series of three bars is represented in the following way, without any spaces between them.



For more than three bars rest it is necessary to use the numeric representation.



This represents a series of 7 bars rest.

The above example is made up of the following signs:

Number sign: 

Number 7: 

Bar rest sign: 

## 6.11 Chords

In Braille music chords are described with reference to a main note, from which harmonic intervals are written in succession. In a piano score chords for the right hand are described by indicating the highest note of the chord and then the intervals below it. The contrary happens for the left hand: the lowest note is first indicated, followed by the successive intervals above.

There are seven basic interval signs:

Second: 

Third: 

Four: 

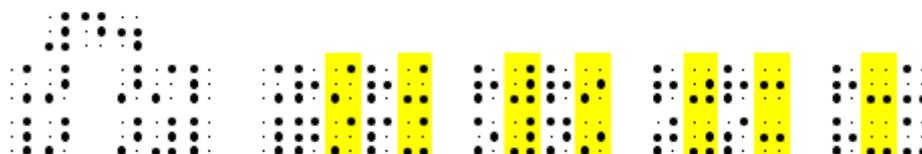
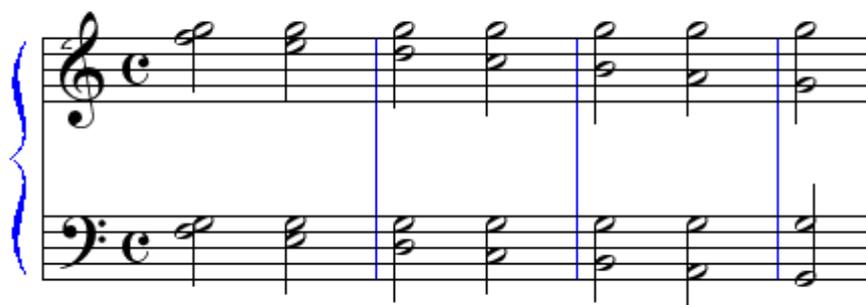
Fifth: 

Sixth: 

Seventh: 

Octave: 

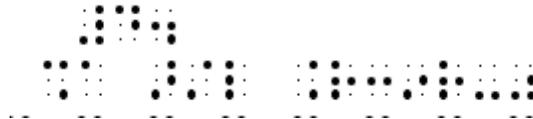
Here are some examples of chords:



Note how in the right-hand score part the note on which chord depends is the top note, the G in the fifth octave, while in the left hand part the fundamental notes are the lower notes, F, E and D, etc. When the chord has an interval larger than an octave, the interval symbol also must be preceded by the octave symbol:



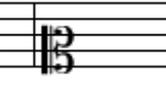
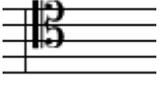
If, however, a chord contains successive intervals within the range of an octave, it is not necessary to specify the octave again.

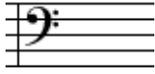
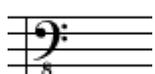


## 6.12 Clefs

In Braille music, clefs do not have the same meaning or the same importance as in printed music. In fact, in Braille, the note's pitch is indicated in an absolute way, so the clef has no effect in defining the pitch of the notes. It becomes useful information only when there is a need to convert music from Braille to print, or when a blind teacher needs to guide sighted students.

The main clefs are the following:

G clef (violin clef)		
G clef an octave higher		
G clef an octave lower		
C clef on the first line		
C clef on the second line		
C clef on the third line		
C clef on the fourth line		
C clef on the fifth line		

F clef		
F clef an octave higher		
F clef an octave lower		
Treble clef on left hand stave		
F clef on right hand stave		

Note that the “treble clef for left hand” and the “F clef for right hand” do not have a corresponding symbol in print. In fact, in printed music the same symbol is always used, while in Braille music it is important to use a specific symbol.

### 6.13 More on the use of contractions in Braille music

This chapter shows further examples of "contractions" in addition to those presented in Chapter 6.4. Braille music has many rules that are designed to avoid the repetition of the same symbols in order to help the musician to better memorise musical patterns, to save time in reading and also to save paper. It is well known that a Braille score requires many more pages than the corresponding printed score. For this reason, whenever possible, it is necessary to try to reduce the number of symbols.

The opportunities for contraction are varied. The main ones are:

#### Sequences of similar bars:

When a score contains repeated bars without any modification, the repeat sign, dots 2,3,5,6, can be used:

Repetition of a single bar:

The image shows a musical staff in bass clef with a 2/4 time signature and a key signature of one flat. The melody consists of two measures: the first measure has a quarter note G2 and a quarter note A2; the second measure has a quarter note B2 and a quarter note C3. This two-measure phrase is repeated. Below the staff, the Braille notation uses the repeat sign (dots 2,3,5,6) to indicate the repetition of the first two measures.

Repetition of 2 similar bars:

The image shows a musical staff in bass clef with a 2/4 time signature and a key signature of one flat. The melody consists of two measures: the first measure has a quarter note G2 and a quarter note A2; the second measure has a quarter note B2 and a quarter note C3. This two-measure phrase is repeated three times. Below the staff, the Braille notation uses the repeat sign (dots 2,3,5,6) to indicate the repetition of the first two measures.



Repeat of 4 or more similar bars



With three or more bars repeated, instead of constantly inserting the repeat sign, it is more convenient to insert it followed by the number (in this case 3), which indicates how many times it is necessary to repeat the bar.

### **Repetition of part of a bar:**

The repeat sign can be used not only for a whole bar (measure) but also for a part of it. If, for example, the second part of the bar (measure) is identical to the first, then the same symbol can be used.

Example:



Contracted form:



Extended form:



In addition, we can use the sign to specify the repetition of a part that has already been repeated.

The following example can be transcribed like this:



The extended version of the same example would be as follows:



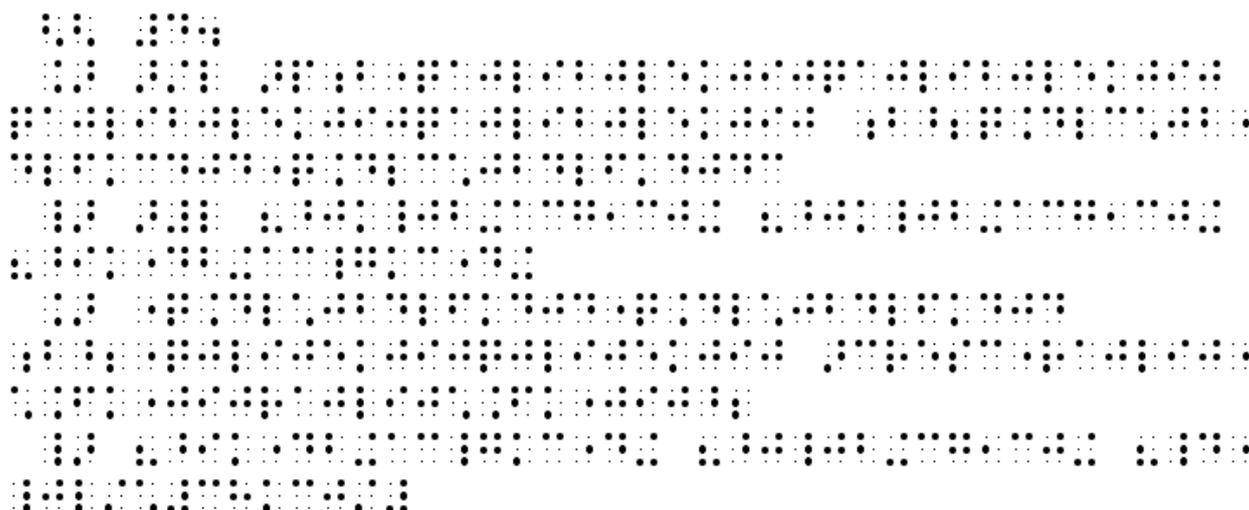
Below is an example suitable for writing in the contracted form:

The image shows a musical score for piano and bass. The piano part is in the upper system, and the bass part is in the lower system. The score is divided into three measures. Red arcs are drawn over the piano part, indicating sections that can be contracted. The first measure has a red arc over the first two measures. The second measure has a red arc over the first two measures. The third measure has a red arc over the first two measures. The piano part starts with a dynamic marking *p*. The bass part has a dynamic marking *4* and a *cresc* marking in the third measure.

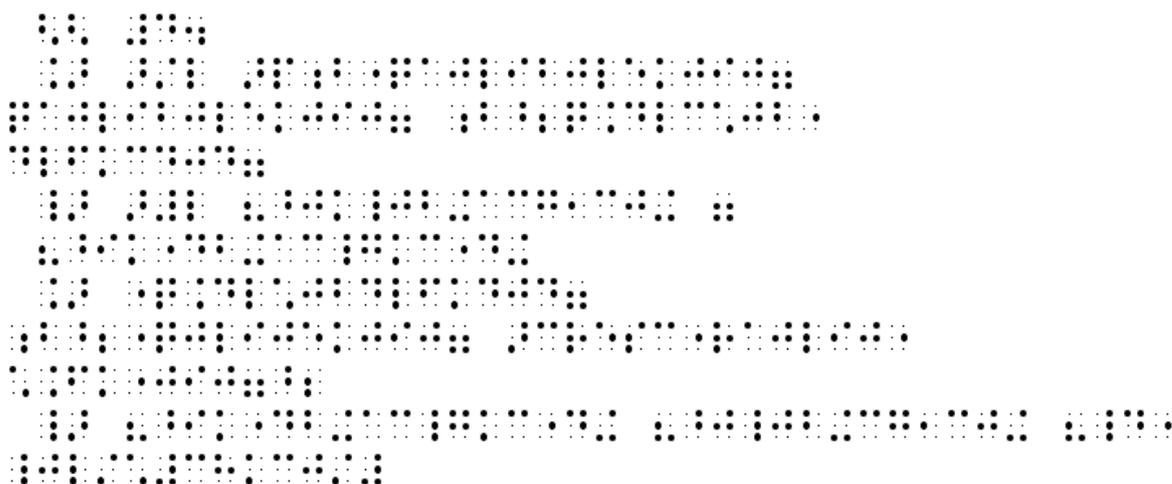
Here is the same piece indicating the parts that can be contracted in the compact form:

The image shows the same musical score as above, but with red bars indicating the parts that can be contracted in the compact form. The piano part has red bars under the first two measures of each of the three measures. The bass part has red bars under the first two measures of each of the three measures. The piano part starts with a dynamic marking *p*. The bass part has a dynamic marking *4* and a *cresc* marking in the third measure.

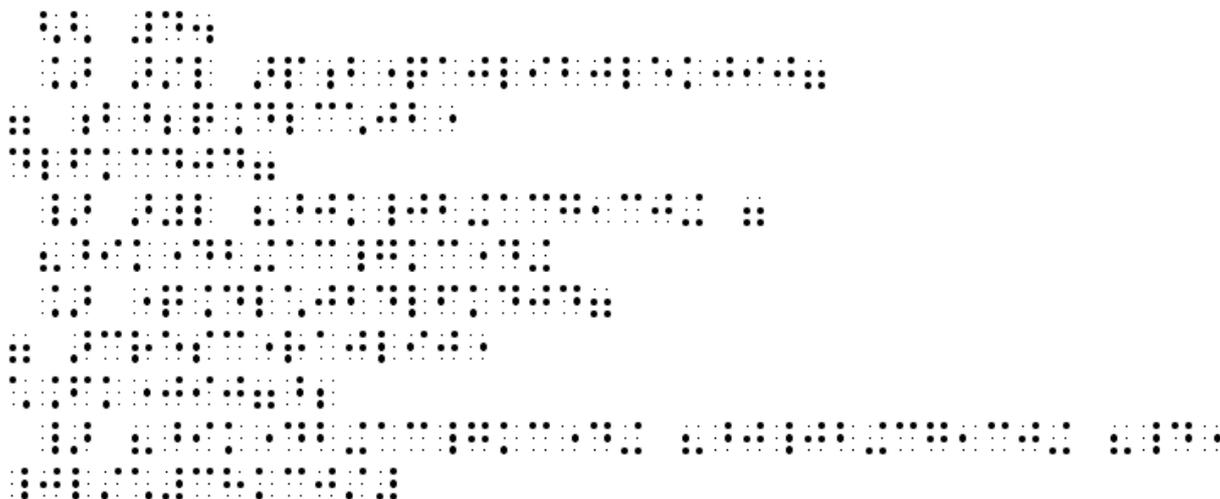
Here is the Braille transcription, first in the expanded form and then with the abbreviation signs:



Contracted form:



Further contracted form:



In the contracted form Braille characters have been reduced by at least a third. As a result, musicians have fewer characters to read and, more importantly, they can better memorise the formal structure of the piece.

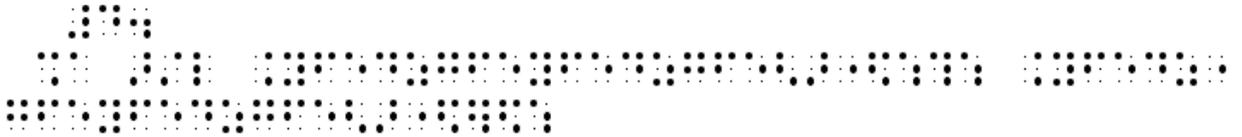
### **Repetition of one musical part within a bar**

The bar repeat sign (2,3,5,6) can also apply to a repeated passage in one part. If in two successive bars we have, for example, the upper voice repeating the same passage, it is possible to use the repeat sign even after the In-accord sign.

For example:



Extended form:



Contracted form:



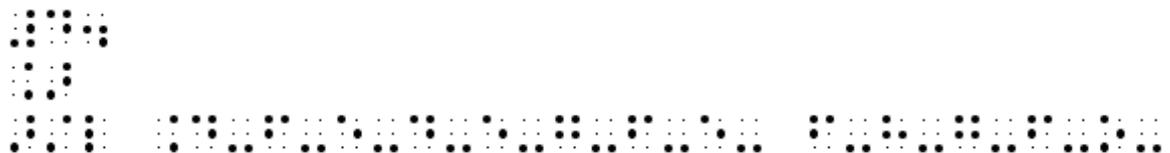
**- Sequences of equal chords**

When, in a part of the score, there is a series of chords of equal interval, this is indicated by doubling the first interval sign. This tells the reader that the subsequent notes are to be played as chords with the same interval.

For example:



This sequence of octaves, if written out in full would appear as follows:



With the use of the doubled octave sign after the first quaver, the notation becomes much more compact and clear:



This rule also applies to chord patterns that involve two or more intervals:



This would be transcribed as follows:



### - Sequences of irrational note groupings (tuplets)

Sequences of irrational note groupings, such as triplets, quintuplets etc., apply the same rule. The appropriate sign is written twice at the beginning of the first group.

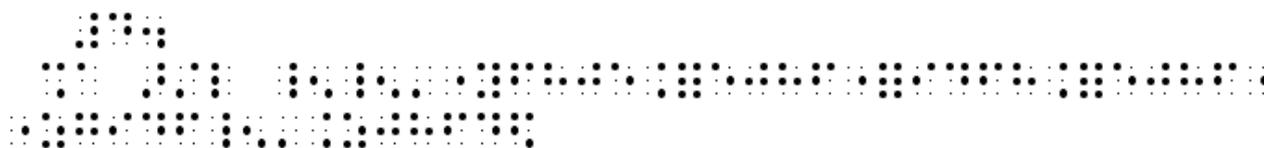
For example:



Written out in full this would appear as follows:



Contracted form:



#### **6.14 Issues related to the reading and memorisation of music: why there is a need for an interactive system for blind musicians.**

Developments in information technology for blind people are mainly concerned with access to and the manipulation of text. Only recently, thanks to research projects such as PLAY2, Wedelmusic, Interactivemusicnetwork, Contrapunctus and Mus4VIP has there been any significant expansion in the use of information technology for music. Blind users are starting to appreciate these innovations and the number of those who prefer electronic scores to their voluminous and cumbersome equivalents embossed on paper is constantly increasing. Many research initiatives highlight a real leap in personal independence and equality of opportunity in the field of music.

Braille music, as shown above, is of a linear sequential type. In other words, each notational element has to be described successively, one after another, following a precise order, with the obvious consequence that it is necessary to hold numerous details in the memory in order to complete the information about simultaneous events. Braille music has to be formed in the musician's mind, in very similar manner to mosaic technique, starting from notes and the various elements to them, such as rhythm dots, ties, fingering, articulation signs and the various notes of the chord in sequence, one after the other. Notes and chords are always represented in a linear sequence in the case of polyphonic pieces too.

As has already been explained, the tactile reading and comprehension of Braille music requires much more time than visual reading. Furthermore, a normally-sighted person is able quickly to select the important elements within a score and ignore, at least initially, the marginal ones. Blind people, reading by touch, are not able to select things with the same speed or concentrate on certain elements whilst omitting others, because they are forced to read sequentially throughout the entire text, without being able to access a specific aspect of it in a direct way. A normally-sighted person can easily and quickly locate musical figures, or just the pitches of notes, whilst ignoring all the surrounding symbology.

This operation cannot, of course, be performed by blind musicians, because they

are not able to simplify the Braille score, hiding some information and highlighting other information, such as the notes only, or only the notes and articulation, or only notes and fingering. In fact, they are always obliged to read the score in its entirety, if they are to understand the structure and organization of the various notational cells. A Braille score is normally available in just a single form, namely as an embossed paper Braille score. Even the few available electronic Braille music scores (mostly in plain text format) are the exact version of the embossed score. Music scores in simplified forms, where one can read just a single class of elements at a time, are not available. Ideally one would start with a score that displayed just the notes (including their rhythmic values and ties). Then one might move on to a score that, in addition to those elements already studied, included fingering and, perhaps, articulation and so on, adding more and more elements until the full version is apprehended. The human eye can focus on certain elements in a selective way and a sighted musician can quite easily decide to focus only on notes, for example, ignoring fingering and dynamics.



*Figure 24: Capacity for visual selection*

Blind musicians, on the contrary, cannot decide to ignore certain elements but are

obliged to read everything in the score, although they might then mentally select those elements which interest them.

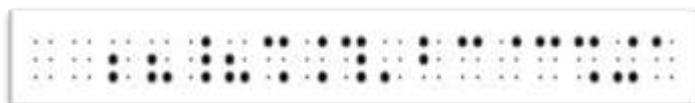
### **Comparison between sighted and blind reading modes**

In order to understand the problems that arise when reading Braille music let us examine a short passage and then compare the two different modes of perception, sighted and blind.

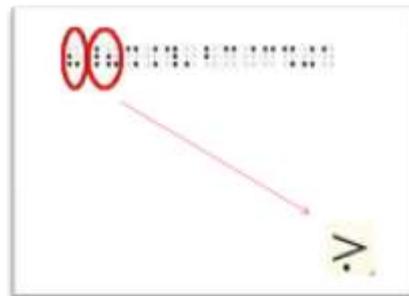
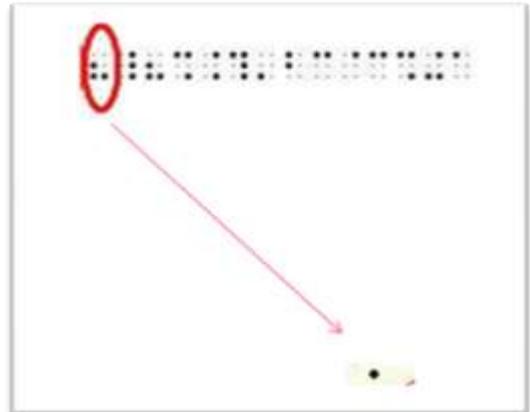


Sighted musicians can very rapidly understand that the above fragment is a diad (or 2-note chord), and subsequently shift their attention to the accidentals, the fingering, the accents and the two ties, as well to the clef and the time indication.

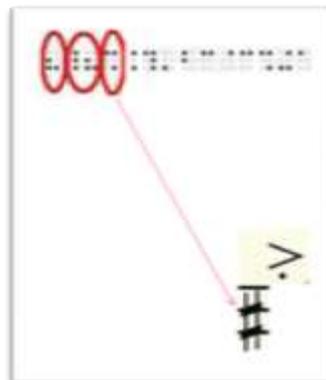
Here is the same passage in Braille:



The first significant sign is simply the indication of a staccato,

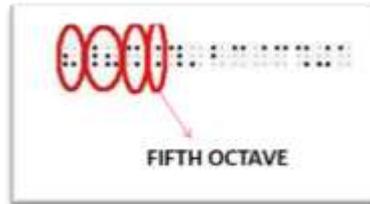


The second and third signs indicate an accent:

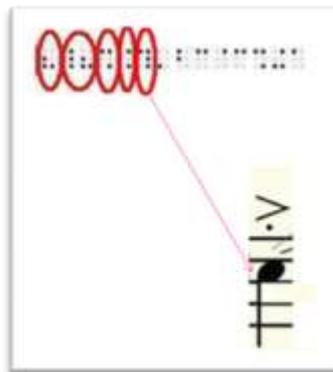


The next sign indicates a sharp:

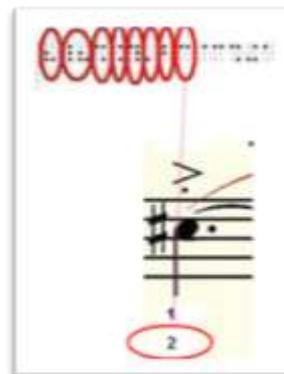
Next comes the octave sign:



Only now does the reader arrive at a note:



This note is associated with a rhythm dot:



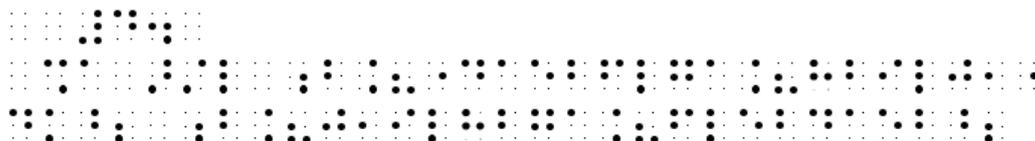
Next comes the fingering:



In this second example, we have two complete bars for right hand, taken from a piano piece:



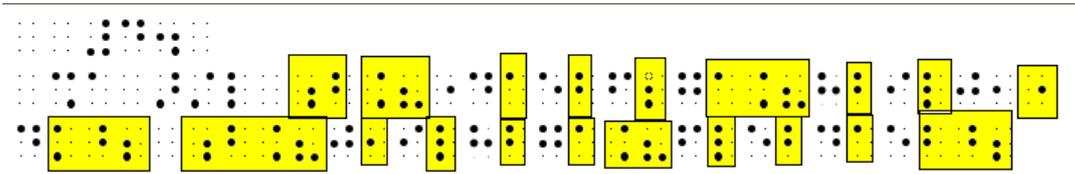
It is possible, at a glance, to see that this is an ascending and descending scale. Given below is the same passage in Braille:



For an initial reading and understanding of this passage, the sighted reader need only pay attention to the notes:



The blind person will have to read all the symbols. In the example below we have highlighted in yellow all the Braille characters not strictly related to information about the notes.



Blind musicians want to be able to decide a priori "how" to read the score, and to entrust to the navigation program the function of highlighting some elements and ignoring others. As shown in the previous examples, a more flexible text reading is extremely helpful in achieving the structured learning of a piece (general knowledge of the piece, studying of specific parts, abstraction of teaching elements, etc.).

As an example, we present a quite common scenario, in which the piano teacher gives the blind student a new piece to be studied. The first task is that of memorising the notes, bit by bit, and this can be only done by first reading the Braille paper music score. The student is obliged, line-by-line, to recognize and interpret all the signs, even those that are not immediately useful but will be required at a later point in the learning process (e.g. accents, dynamics, ornaments, etc.). Then, having put the book on a small table next to the performer, (light and easily movable to the right or left, according to need) or on one side or on the legs, the student plays small fragments on the piano, constantly moving his/her hand from the keyboard to the Braille text. The great difficulty for the student is losing their place and not being able quickly to identify the phrase or bars that follow those just read. As a result the student is often forced to start again from the beginning of the page.

Obviously, if the student has had the opportunity to listen to the assigned piece, or to part of it, or perhaps a passage played by the teacher then learning can proceed more quickly. It may be that the student will refer to a recording. This certainly aids the learning process but it does not draw the student's attention to those signs that do not have a precise sound feedback (fingering, staccatos, possibly the crossing of hands, passage of the thumb, etc.).

From a practical point of view it is important to ensure that the Braille score is always very stable on the supporting surface. If desired, one can use a simple adhesive sign in the margin of the last line read, to facilitate the return to one's place.

At this stage, the student would prefer to have the score in a reduced form. This would help him/her to read a quickly the notes alone as well as quickly associating notes to fingering, temporarily leaving out all the other signs that would be added in a second phase of the study.

We can see, therefore, the benefits that may result from the use of a score navigation program in electronic format, that is able to break up the score itself, and to provide the reader with only the elements that they choose, for example:

- only to display the notes of the right hand or of the left in a piano piece;
- only to display a voice, for example in a polyphonic piece, even when it is shared between the two hands.
- only to display notes (and chords) plus fingering;
- only to display notes (and chords) plus ties;
- only to display notes and phrasing marks;
- and so on ... with all the possible combinations.

The possibility of displaying only the notational elements chosen is a solution that enormously facilitates the process of score learning and memorisation. This technique can be adapted to the capabilities and needs of an individual student and provides the teacher with a powerful tool for trying new teaching strategies, leading to fully customised learning.

### **What is the solution?**

A valid solution to the needs expressed by blind musicians involves an important prerequisite - namely the possibility of using a Braille electronic format score. This format should be easily manageable through an editor, or through a reading / navi-

gation program provided with a proper interface not only for querying, but also for Braille presentation, listening via MIDI and listening via speech synthesis that reads in natural language the individual score elements, under the guidance of the user.

For this purpose the BMML code has been realized by the *Contrapunctus* project. It is capable of storing and describing Braille format music using the XML standard. BMML is aligned to the standard of the international handbook, but it is also able to accept and interpret other elements of Braille music tradition still used at national level.

The code having been completed, however, there still remains the problem of how to convert thousands of scores already transcribed into Braille music using the plain text digital format (ASCII) into the new BMML code.

It is a laborious task that, were it to be carried out manually, would require more or less the same time needed to rewrite the original Braille text, starting from the original printed music. The music cannot be simply copied, it is also necessary to interpret it and associate each musical element with the corresponding marker of the BMML code.

A solution to this has been created within the European project *Contrapunctus* that has produced:

- a conversion program that produces BMML files starting from MusicXML, which is a widely used format for the storage of traditional music.
- the Resonare editor, which is a program that can recognize the music Braille text in ASCII format, identify and understand all the musical elements present according to the rules of the new international handbook but also integrated with rules from some of the main handbooks widely used in the past. This program also allows you to force text sequences to be associated with specific music markers, in order that they can be manipulated by an operator.
- the Braille Music Reader player (BMR), which allows you to open, read and query a BMML music file for specific study and memorisation needs. The

BMR program can be viewed as an interactive multimedia notebook, and allows you to explore the structures of the Braille score according to different interpretations and at different levels, search for instrumental or vocal passages, insert text or symbolic annotations and quickly access the information itself. In fact, just as with standard scores, so it is necessary when using Braille music to add markings, such as the teacher's comments or information related to the analysis of the piece.

- The *Contrapunctus* Project analysed all the common models and on-line services in order to propose a solution for the future of a centralized archive of BMML format scores:

The impact of the *Contrapunctus* Project and of its results will be to bring many benefits and significant changes in the following areas:

- it will offer a new approach and a renewed mode of music study to young students,
- it will lead to different methods of producing new scores by libraries and transcription centres,
- more generally, it will offer a greater chance of producing new Braille scores,
- it will facilitate the bidirectional communication (amongst blind and sighted people in different learning contexts: between teacher and student, blind music teacher and students).
- it will make for easier access to the Braille music world for all those people who lost their sight in adulthood and still have the desire to play or to study music (this through the combination of MIDI music and the spoken interpretation of Braille signs),
- it will facilitate the interactive learning of Braille music notation (supported by the MIDI music and speech),
- it will facilitate the exchange of materials amongst music libraries, avoiding duplications and thus reducing operating costs;
- it will ensure the creation of new employment opportunities for blind people

in the field of music (teacher, performer, musicologist).

Basically, the main benefit that has been introduced, thanks to the *Contrapunctus* Project, is derives from the development of the BMML format that ensures Braille music a new flexibility and a better usability, in a way that makes it more interesting and easier to access, especially for beginners.



## 7. BMML Development

### 7.1 BMML – the basics

BMML stands for *Braille Music Markup Language* and it is an XML encoding for music Braille notation. To meet the diverse needs, BMML has been designed with the following objectives:

- Coding the structure and content of music Braille notation, according to the New International Handbook of Braille Music Notation.
- Facilitating the conversion to and from other music notation codes, particularly standard notation ones such as MusicXML or Wedelmusic.
- Sufficient flexibility for it to be extended to Braille music variants used in the different countries.

BMML is based on XML syntax rules. Grammatical aspects are specified by a Document Type Definition, or DTD or, alternatively, by an XML Scheme.

The names of elements and attributes are written in lowercase and compound names are separated by "\_" as in "score\_header."

### 7.2 Elements

The elements of BMML are of two types: containing elements and text elements.

This classification does not include items in the heading, for example children or score\_header, in which all the data relating to the storage of the document and to its structure are encoded.

Containing elements require a specific number of children, but they have no textual content. Children elements can be either containing elements or text elements. Containing elements allow you to group elements and their meanings in order to create a higher level of abstraction. The first containing element, the root of a BMML document, is the score element. Another important containing element is the element “notes”, which brings together several elements such as accidental, octave, note\_type.

The text elements are located at the end of the chain and do not have children. They have a textual content that represents the Braille text within the document. To avoid the confusion caused by the use of several tables, necessary to adapt the final product to the different languages and national practices, Unicode patterns are used, as established by the Unicode Consortium ([www.unicode.org](http://www.unicode.org)) included between 2800 - 283F. To facilitate the reading and administration of textual data, numeric references have been used, instead of fonts. For example, the Braille symbol that corresponds to the sign containing point 1 can be encoded by the 2801 hexadecimal Unicode character or by the numeric reference to the character `&#x2801`.

### 7.2.1 Attributes

The XML attributes are used in BMML to encode the meaning of text elements. Most of these attributes are required by the Braille syntax. For example, the *octave* element has a *value* attribute that specifies the number of the octave, as in

```
<octave value="4">&#x2810:</octave>
```

According to the XML syntax, attributes are strings between double (") or single (') inverted comas. Values of allowed attributes are described as follows:

- strings, as = "mordent"
- wholes, as = "1"

- tuple of wholes , such as = "0.1"
- tuple of strings, such as = "3 +4.1024"
- Boolean, such as = "true"
- tuple of tuples, such as = "3 +4.1024; 3.256"

The default values for attributes that are not required are not defined, so they can be considered as invalid.

The value of all these attributes of elements can be determined by the use of various tables that associate each element and its Braille representation to a value or group of values. This, however, implies that each editor or reading program must have access to the various tables. Moreover, if an extension has been coded according to a specific Braille convention, used in a particular country, it will be given a corresponding table in order to manage the BMML document properly. For this reason it has been decided to establish – for the writer - the necessity to specify the required attributes and allow the reader the access to a document, as well as manage it without any additional data or table. Usually, the person in charge of writing, as we shall see later on, needs a more elaborate logic to produce the document, while for those who read everything is very simple.

Thus, in the previous example

```
<octave value="4"&#x2801</octave>
```

the octave value is 4 even if the Braille description were then indicated in a different way.

## 7.2.2 Data

While attributes, as described above, can be determined through a simple table mapping operation, there are other types of data that have to be calculated using more complex algorithms. Let's consider the *note* element: its pitch and duration, for example, depend upon its children, but also on previous and subsequent elements, since pitch depends on the previous note if the *octave* element is not present and the entire duration depends upon the whole bar to which the *note* element belongs.

To take these data and their complexity into account, it was not possible to encode them as attributes. So, an *xxx\_data* element was defined, the first children of the *xxx* element it belongs to. Children of data elements are of different types as described below.

## 7.2.3 id

Each element in the BMML system has a mandatory **id** attribute (*processing id*). The value of this attribute is unique, and unequivocally identifies an element. This value is used to refer to the element for the administration of repetitions or doubles, as we read in the presentation chapter about Braille music syntax. The value can be a string or a number or a combination of both, since the only constraint is its uniqueness within the document.

## 7.2.4 “New line” and “space” characters

In Braille musical notation the "new line" and "space" fonts have a particular importance and can assume different meanings depending on their location. They are used to convey layout information, such as the utilisation (now codified by all

printing houses) of the three spaces before the start of a new section to help the blind user find this sign in a Braille sheet, or they may be bar lines.

The utilization of these XML fonts (as the *XML recommendation*, sections 2.10 and 2.11, text indicates) may lead to different results, depending on the XML processor. To avoid confusion and possible mistakes, we used the corresponding font numerical reference, and therefore a *newline* element and a *barline* element are encoded as follows:

```
<newline>&#xa</newline>
<barline attrs="..."> &#xa </barline>
```

In XML, space font within the content will be preserved, but errors can arise from the compacting of more spaces, as is the case in HTML, or by different implementations of XML parsers. Again, to avoid confusion and possible mistakes, we used the empty Braille cell corresponding to Braille pattern Unicode 2800. In this way, a *space* element and a *barline* one are encoded as:

```
<space>&#x2800;</space>
<barline attrs="...">&#x2800;</barline>
```

### 7.2.5 Duration of music figures

Usually the duration of a musical note is represented by a fraction, for example  $\frac{1}{4}$ , denoting a crotchet (quarter note) or  $\frac{1}{8}$  for a quaver (eighth note) etc., or by a whole value such as 1, denoting a semibreve (whole note) or 2 for a breve (double whole note).

In BMML the representation of  $\frac{1}{4}$  is hereby given by a value equal to 1024. The value of 1024 was chosen to be high enough to take into account small values and the addition of *dotted notes* that modify the duration of the note. Accordingly, the corresponding numerical values are:

• Long (Quadruple Whole Note)	16384
• Breve (Double Whole Note)	8192
• Semibreve (Whole Note)	4096
• Minim (Half Note)	2048
• Crotchet (Quarter Note)	1024
• Quaver (Eighth Note)	512
• Semiquaver (Sixteenth Note)	256
• Demisemiquaver (Thirty-second note)	64
• Hemidemisemiquaver (Sixty-fourth note)	32
• Quasihemidemisemiquaver (one hundred twenty-eighth note)	16

To ensure the correct durational value of notes, without losing the effectiveness and portability of the entire representation, the length always refers to the notes or rests in their original value. There is an additional parameter, which states the "normal" number of notes (in the absence of any irrational rhythmic grouping) and the number of notes as amended by an irrational rhythmic grouping. For example, a quaver (eighth note) in a triplet will have a duration value of 512 while the parameters for the real notes and the specific note of the triplet grouping are declared as 3 notes instead of 2. The actual duration can be easily calculated using the formula  $512 * \frac{2}{3} = 341,3$ . This is a fractional value and can be managed in an appropriate way by the software editor, if necessary. For example, an editor or a reader that, starting from a BMML document, creates a MIDI sequence, will consider the single values of the entire triplet and then play three notes instead of two, bearing in mind that the values of single notes must be rounded up or down to integers in order to achieve the total value which, in this case, is of 1024.

## 7.3 The BMML elements

The detailed description of the BMML elements is available as DTD and XML Schema. The following chapters will provide a general discussion of the BMML structure and its basic elements, using some simple introductory examples.

### 7.3.1 Let's explore the BMML format

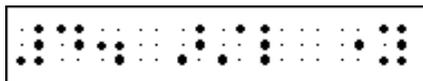
Let's now explore the BMML format through a simple example:

Middle C (the note **C** in the fourth octave) semibreve (whole note) written in

$\frac{4}{4}$  time in treble clef:



The Braille equivalent is:



In this simple example we can distinguish three main elements: *time\_signature*, *clef* and *note*. In BMML this is expressed by:

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
```

```
<!DOCTYPE score>
```

```
<score version="1.0">
```

```
  <score_header>
```

```
    <part_list>
```

```
      <part_data id="bmml-p00" chord_dir="dn">
```

```

        <name/>
    </part_data>
</part_list>
</score_header>
<time_signature id="bmml-0002" values="4,1024">&#x283c;&#x2819;&#x2832;</time_signature>
<space id="bmml-0003">&#x2800;</space>
<part id="bmml-p00">
    <clef id="bmml-0004" name="G" line="2">&#x281c;&#x280c;&#x2807;</clef>
    <space id="bmml-0005">&#x2800;</space>
    <note id="bmml-0006">
        <data>
            <pitch>28</pitch>
            <duration>4096</duration>
        </data>
        <octave id="bmml-0007" value="4">&#x2810;</octave>
        <note_type id="bmml-0008" name="C" value="whole_or_16th">&#x283d;</note_type>
    </note>
</part>
</score>

```

By examining the code, we can analyse each single element.

```
<score version="1.0">
```

The *score* element is the root element of a BMML document and its version attribute is mandatory.

The *score\_header* element is the container of all the elements that are not in the Braille music document but are used to manage the document itself properly, such

as *part\_list* or *meta\_data*.

The *part\_list* element is the only mandatory one, and it lists all the parts used in the document.

```
<part_data id="bmml-p00" chord_dir="dn">
  <name/>
</part_data>
```

In this example we only have one part. The attributes of our part are an **id**, which clearly identifies the part itself and the reading direction of the intervals of a chord. The part has a *name* element that is empty until a specific name for the part is declared.

After the *score\_header* element there is the list of elements present in the Braille document. Our document begins with a *time\_signature* element.

```
<time_signature id="bmml-0002" values="4,1024">&#x283c;&#x2819;&#x2832;</time_signature>
```

The Braille text corresponding to time is described with a numeric reference to the character and it gives a clear value for the bar in terms of time and music durations.

Indeed, the attribute that indicates the correct value for  $\frac{4}{4}$  time is number 4 (to identify measures) while the value of 1024 is to indicate the value of each measure. If time had been written as a simple time or as a "C" we would have found the "csymbol" attribute with the value of the "C" letter.

After the time signature, in Braille, it is necessary to insert a space followed by the *part* element. At this point a brief explanation is needed to clarify that time is not a child element of the *part* element. In this example, having just one part, the *time\_signature* can be either a *part* child or not, since this does not entail changes in the musical sense. So, our example could also have been written as:

....

```
<part id="bmml-p00">
  <time_signature id="bmml-0002" values="4,1024">&#x283c;&#x2819;&#x2832;</time_signature>
  <space id="bmml-0003">&#x2800;</space>
```

Usually, in scores with more parts the time signature is written before the parts themselves and it is applied to all those subsequently represented.

The **id** attribute of the *part* element must correspond to the *part\_data* attribute to recover the useful data applied to the part, such as the reading direction of the intervals of a chord.

As a child of the *part* element, the music text is associated with this part. In the example they are a *clef* element and a *note* element.

```
<clef id="bmml-0004" name="G" line="2">&#x281c;&#x280c;&#x2807;</clef>
```

Clefs are not always used in Braille music, but they are useful for a proper conversion of the Braille document into a standard format such as MusicXML. If the *clef* element is not present, the conversion program will check whether there is a *clef* default element as a child of the corresponding *part\_data* element and, if so, it will use that element. If it is not present, then the conversion program must decide which clef is suitable, whether treble clef or some other. This could be decided by using an algorithm or some other musical text analysis method.

The *note* element requires a more extensive discussion and it is fully addressed in the next section.

The simple example above shows the basic structural principles that are fundamental to the BMML code. It is especially important to notice the difference between the two groups, *score\_header* and *score\_data*. The *score\_data* element and its structure can handle a Braille score written in a "line by line" or "section by section" form

and at the same time it can preserve the original layout of the document.

### 7.3.2 The *Note* element

The *note* element is the most complex one in a BMML score. It has numerous children and various defined parameters in order to take account of the various elements that form it. Let us start with a simple example, like the one presented above:

```
<note id="bmml-0006">
  <note_data>
    <pitch>28</pitch>
    <duration>4096</duration>
  </note_data>
  <octave id="bmml-0007" value="4">#x2810;</octave>
  <note_type id="bmml-0008" name="C" value="whole_or_16th">#x283d;</note_type>
</note>
```

The first child of a *note* element is a *note\_data* element in which are described all the parameters that belong to the note and that can be "calculated", i.e. that they are not solely determined by the Braille representation of this particular note, but they require a more extensive analysis of the document and depend on what is written before or after.

The *pitch* element indicates the absolute pitch of the note, and the value 28 corresponds to the middle **C**.

```
<pitch>28</pitch>
```

If the pitch value is derived from an editor or from the conversion of a music score into Braille language, it can be calculated either by using the element *octave + name of the note* (if present as an child of the *note* element) or according to the

value of the previous note's pitch, as established by the Braille rule described in NIM<sup>27</sup> 1-10. This rule indicates when and whether to repeat the octave sign before the name of a note.

If the note is altered by an accidental written before the note, by an accidental applied to a previous note in the same bar or by a change of key signature, they are followed by an *alteration* element. The *alteration* element is present only if used. If necessary, to show the alteration the optional *show* attribute can be used.

The *duration* element corresponds to the real duration of the note. According to the Braille rule (NIM 1-1) the Braille symbol used for the note can have two possible values and it is necessary to determine the real duration of the note using the value attribution of the *note\_type* element, time signature and consider the values of the other notes in the same measure.

So, the note in our Braille example is represented by two elements: the *octave* and the *pitch*

```
<octave id="bmml-0007" value="4">#x2810;</octave>
<note_type id="bmml-0008" name="C" value="whole_or_16th">#x283d;</note_type>
```

The value attribute for the *octave* element simply varies from 0 to 7.

The name attribute for the *pitch* element is simply the name of the note. More interesting is the value attribute that considers the fact that a Braille note can have two possibilities of duration and that its real duration must be determined from the context.

Thanks to the *data* element and its children it is therefore possible to describe a note fully. A software reader does not need, for example, to perform additional calculations to define the corresponding sound. In our simple example, converting the note in a MIDI sound is very easy, because you know the absolute pitch and its du-

---

<sup>27</sup> International Braille Music Notation Handbook

ration. A software reader can clearly identify for the meaning of each Braille character in the document and this information, in this case "Fourth Octave" and "C", will be spoken by the speech synthesis.

Other important aspects related to the *data* element are described in the sections on "doubling" and "repetition".

### 7.3.3 Time signatures

To represent time signatures, the attributes *values* are utilised as follows:

```
<time_signature id="bmml-0002" values="4,1024">&#x283c;&#x2819;&#x2832;</time_signature>
```

For so-called common time, the *csymbol* attribute is used with "C" or "c" value

```
<time_signature id="bmml-0002" values="4,1024" csymbol="C">&#x2828;&#x2809;</time_signature>
```

Other available attributes are: *figure*, to indicate that a note appears in the time signatures, and *single\_number* to indicate that the time signatures is written using only a single number.

To cope with compound time signatures, the value attribute can be written as follows:

For a time signature of  $7/4$  divided as  $3+4$ :

```
values = "3 +4.1024"
```

For alternating  $3/4$  and  $3/8$  time signatures

```
values = "3.1024; 3,512" (NIM 13-19).
```

### 7.3.4 Music clef

In BMML, the treble clef is represented as shown below:

```
<clef id="bmml-0004" name="G" line="2">#x281c;#x280c;#x2807;</clef>
```

The name attribute can be "G", "F" or "C", while the line attribute is used to define the line on which the clef is placed. For treble clef the line attribute can be omitted, as well as for the F one on the fourth line.

Other attributes include *eight* that can be "above" or "below" to encode a clef that sounds an octave above or below the written pitch, and *cross\_staff*, which can be "true" to encode clefs included in the Braille document. This is particularly useful for blind teachers of sighted students. (NIM 15-14).

### 7.3.5 Bar line

A Braille bar line is denoted by a space, a new line or with a combination of Braille signs. In BMML the bar line is written as:

```
<barline id="bmml-0001" value="space">#2800;</barline>
```

or

```
<barline id="bmml-0001" value="newline">#0a;</barline>
```

The *barline* element has a value attribute that is a string that expresses the type of bar line. This attribute is useful for conversion to a standard encoding format.

### 7.3.6 Tuplet

In Braille music language, the tuplet is indicated by one or more Braille symbols positioned before the relevant notes. Determining where the tuplet ends is sometimes more complex in Braille than in standard notation where an aid is usually provided by a line above or below the notes and/or by the presence of beams. In BMML the *tuplet* element is used to encode the Braille sign and this can also be doubled in the case of tuplet sequences. In the *note\_data* of corresponding notes the *tuplet\_ref* element is used to take into account the effect of the tuplet sign.

```
<note id="bmml-0001">
  <note_data>
    <pitch>35</pitch>
    <duration>512</duration>
    <tuplets>
      <tuplet_ref id="bmml-0002" notes="2,3" type="start"/>
    </tuplets>
  </data>
  <tuplet id="bmml-0002" value="3">&#x2806</tuplet>
  <note_type id="bmml-0003" name="C" value="8th_or_128th">&#x2819;</note_type>
</note>
```

The *tuplet\_ref* element is a reference to the *tuplet* element and has the same **id** attribute. The *notes* attribute refers to the change of duration generated by the tuplet. In our example, 2.3 is read as 3 instead of 2 and the actual duration of the note will be:

$$512 * \frac{2}{3} = 341,3\dots$$

The *type* attribute may be "start", "stop" or "continue" to determine the position of the note in the tuplet.

Nested tuplets can be easily managed by using two different *tuplet\_ref* elements that refer to two different *tuplet* elements.

### 7.3.7 Music Beams

An important difference between standard notation and the Braille one is the use of beams (NIM 4-1 et seq.) A beam in musical notation is a thick line used to connect multiple consecutive quavers (eighth notes), or notes of shorter value (indicated by two or more beams). The notes are grouped together in beats to help give a sense of the underlying metre. In Braille we try to get a similar effect, writing the first note as it is, and the following ones as if they were quavers (eighth notes). The beamed notes, apart from the first one, appear as octaves: the duration element must take this convention into account and express the actual duration of the note.

### 7.3.8 Doubling

Doubling is used in Braille as an abbreviation solution to save characters - and paper, if the document should be printed. This rule consists of doubling a Braille sign the first time it appears: its effect will remain until the sign is written again. For example, a series of notes with a staccato sign are expressed in Braille by writing the first note preceded by two staccato signs, and then writing the other notes in the series without the staccato sign and the last note with a single staccato sign. The staccato effect applies to all notes in the series and in Braille music several characters are saved.

The elements that can be doubled are many and of different types. These elements are all children of the note or the rest. The proper managing of the doubling is processed in the *note\_data* element.

Let's consider now the previous case. In Braille we have:



The first note in the BMML measure is:

```
<note id="bmml-0001">
  <data>
    <pitch>35</pitch>
    <duration>1024</duration>
    <nuances>
      <nuance_ref id="bmml-002"/>
    </nuances>
  </data>
  <nuance id="bmml-002" value="staccato" doubled="true">&#x2826;</nuance>
  <octave id="bmml-0003" value="5">&#x2828;</octave>
  <note_type id="bmml-0004" name="C" value="quarter_or_64th">&#x2839;</note_type>
</note>
```

The following note is not preceded by a “staccato” sign but it applies the previous staccato sign. So in BMML it will be:



```

<duration>1024</duration>

<intervals>
  <interval_ref id="bmml-0004">
    <pitch>36</pitch>
  <interval_ref>
</intervals/>
</data>
<octave id="bmml-0002" value="4">&#x2810;</octave>
<note_type id="bmml-0003" name="B" value="quarter_or_64th">&#x283a;</note_type>
<interval id="bmml-0004" value="3" doubled="true">&#x282c;</interval>
</note>

```

The *interval\_ref* element refers to the *interval* element and contains a *pitch* compulsory element to express pitch itself. The following note, as with staccato signs seen above, will have an *interval\_ref* element that refers to the same *interval* element, but obviously with different pitch.

As for notes, intervals may have accidentals and / or ties. All these elements are used in the same way as the *pitch* element.



## 8. Resonare: Braille music recognition software

*Resonare* is a Braille music recognition and contextualization software. The program has a text file (ASCII format) produced for Braille printing and a Braille music score and so, following the rules of Braille music notation (from the International Handbook,<sup>28</sup> it recognizes the characters and assigns them their correct semantic meaning in order to generate a BMML format file.

*Resonare* is much more than a simple recognition system for Braille music, as it is able to identify not only the meaning of each symbol but also its semantic function within the score. To use a linguistic analogy, *Resonare* recognizes nouns, adjectives, pronouns, verbs and so on, as in the analysis of a literary phrase.

Due to the great complexity and variety of Braille music syntax, the program also offers the operator the possibility of intervening during the recognition phase in such a way as to force the program to adopt a particular interpretation of the code. This interaction is based on the use of "additional markers", which have the function of making all processes more understandable and easier to manipulate from the point of view of the transcriber. A marker identifies a specific symbol or a sequence of Braille symbols, and associates them with a defined music object (note, rest, alteration, etc.), or to a music element that can be recognized only if combined with other elements (the beginning of a tie, an octave sign, the start of a dy-

---

<sup>28</sup> Braille music notation has a section dedicated to musical elements, and one dedicated to textual elements, such as critical apparatus, didactic information, and the like

dynamic marking, a passage with simultaneous parts, In-accord signs, etc.).

The *Resonare* program was created in response to the need to recover thousands of Braille scores, from the earliest examples, made by numerous different transcription centres and currently only available on paper. Some of the most recent are also available in electronic text format for use with innovative computer programs and the new BMML format.

## 8.1 Features of the *Resonare* program

Listed below are the main features of the *Resonare* program, and the different functions that it offers:

- importing an ASCII Braille music file;
- recognising the file's notational elements in an automatic way and also through the instructions given by the operator who interacts with the program;
- identifying and interpreting each musical element based on its location and context (note, rest, clef, chord, etc.), following the International Handbook syntax, or the rules contained in the main Braille music notation handbooks;
- exporting the processed BMML format file;

The *Resonare* program has a user interface full of graphic elements that really facilitate the transcriber in the work of verifying and correcting the musical text.

## 8.2 How the *Resonare* editor works

*Resonare* operates through three main modules:

- the user interface that allows the transcriber to open a file, verify and correct the recognized text,
- the recognition module,
- the contextualization module of the recognized elements.

The interface allows the operator to perform the typical functions of Braille music text editing: selecting, highlighting, assigning a value, copying and pasting, typing new text or correcting a previously processed text.

The recognition module performs its operation following the rules contained in a file named "rules.txt."

The contextualization module collects all recognized elements (tokens), places them in a structure ("syntax tree or parse-tree") and assigns them their correct value (chromatic alterations, pitch, values, fingering, accents, voice and so on).

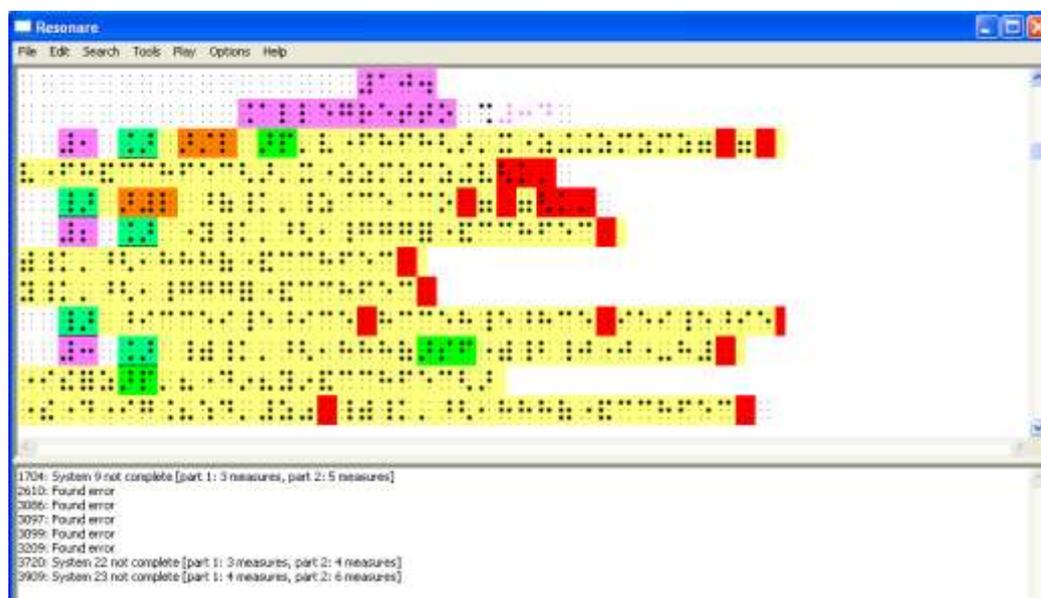


Figure 25: How the *Resonare* interface appears in a Braille score processing phase

Given below is a chart showing all the required steps for the recognition process. Braille characters are represented by two-digit integers between 01 and 65, which correspond to the classic Braille signs numbering, plus the white space (sign 64) and the sign of a new line (65).

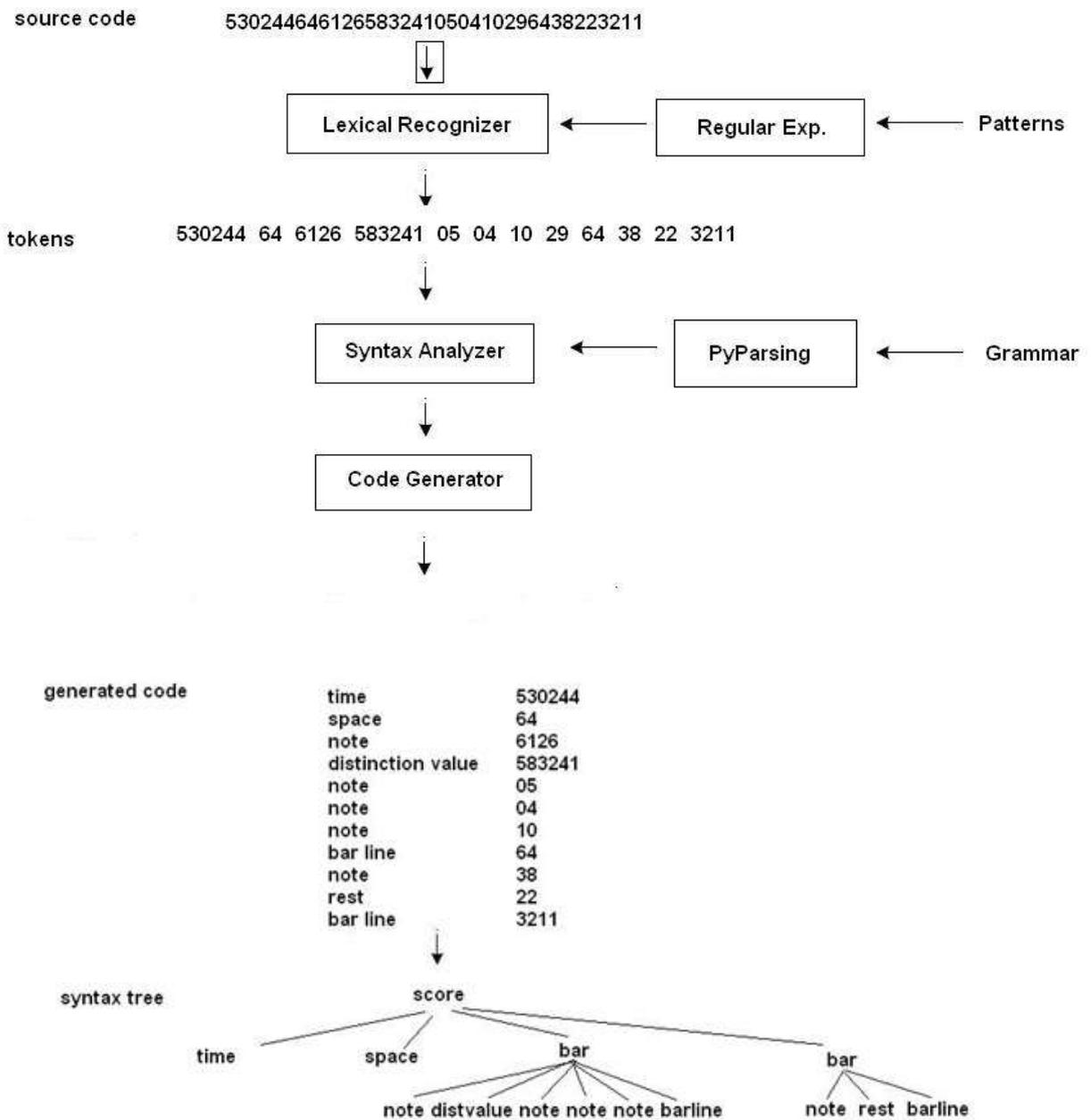


Figure 26: Resonare software structure

At the end of the recognition process the piece is displayed through the *Resonare* editor interface

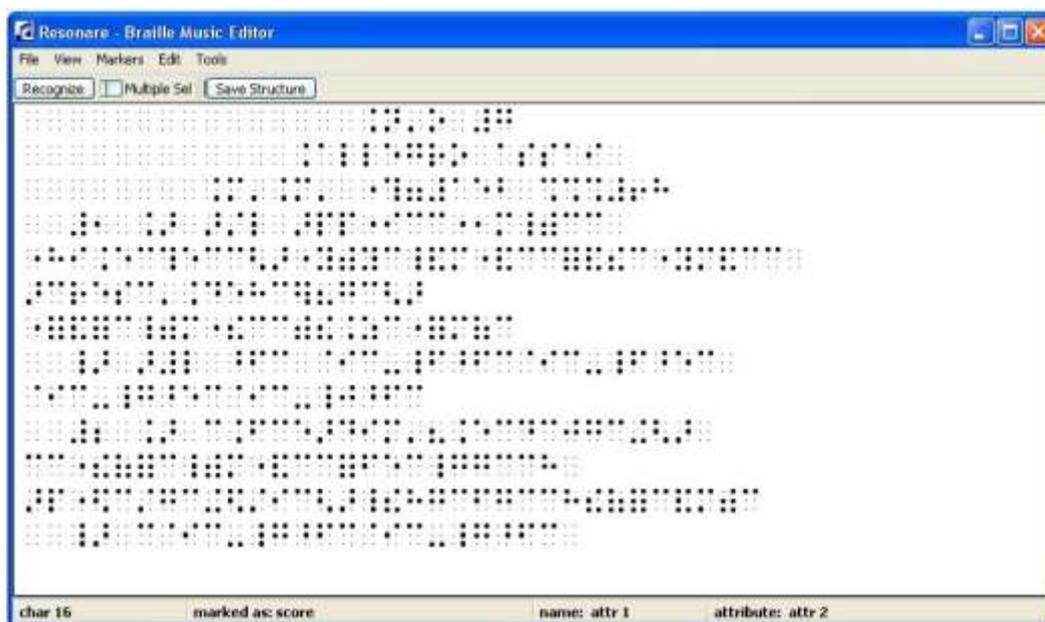


Figure 27: Resonare Editor Interface

## 9. Existing research and projects on music and Braille

### 9.1 National and European Projects about music and Braille implemented in the past

One of the first attempts to make an online music Braille library was initiated by the Dutch printing office FNB, now renamed "Dedicon", with the European project "Miracle" <sup>29</sup>, which at the end of the project created an online web portal in which it was only possible to examine the catalogues of 4 libraries (United Kingdom, the Netherlands, Spain and Switzerland).

The European "e-Brass" project (2008), benefiting from the innovations introduced by "Miracle" and the results of the PLAY2 project<sup>30</sup>, performed an analysis and a market survey to verify the feasibility of developing a unified service of online Braille music scores distribution.

The American community "Bookshare.org" provides a service for sharing scanned printed music scores distributed in electronic format and (only in the United States) is free of copyright protection, for users with sight disabilities, for those works and formats considered appropriate to their needs.

---

<sup>29</sup> <http://cordis.europa.eu/libraries/en/projects/miracle.html>

<sup>30</sup> The European project "PLAY2", created in 2004 a demonstrative archive of music scores using the proprietary format "Play" and the program "Braille Music Editor 1.0". [http://www.dodiesis.com/index.php?q=play2\\_it](http://www.dodiesis.com/index.php?q=play2_it)

Another European project that dealt with issues related to copyright for accessible archives is "Sedodel" - Secure Document Delivery for Blind and Partially Sighted People (1999-2001) <sup>31</sup>, coordinated by Harry Knops <sup>32</sup>. Sedodel had the objective of proposing a new solution for the safe management of accessible electronic documents (including those distributed online), taking into account the different formats available and the possibilities for converting documents into formats more easily usable by people with specific requirements, and protecting publishers against illegal copies, with authentication technologies such as smart card, which could also be used for online payments.

Finally, "EUAIN"<sup>33</sup>, the European Network for Accessible Information (2004-2008) coordinated by the Amsterdam based "Dedicon", addresses the issue of accessibility and copyright as a priority, especially regarding the diffusion of online information.

Listed in the next section are the main European projects that have addressed the music and accessibility issue and are relevant to the MUS4VIP project.

## 9.2 Existing research and projects

Many projects have undertaken research into Braille music and it is important to learn from the outcomes of these projects – which elements were successful and which endeavours proved to be fruitless. This section provides an overview of previous projects and highlights how the project results are important for the Music4VIP project.

Many of the projects surveyed here have received European funding. As such this section can be seen as an indication of the evolution of the research across Europe into Accessible Music in recent years.

---

<sup>31</sup> [http://www.snv.jussieu.fr/inova/publi/csun\\_99.htm](http://www.snv.jussieu.fr/inova/publi/csun_99.htm); or

[http://www.dinf.ne.jp/doc/english/Us\\_Eu/conf/tide98/114/engelen\\_jan.html](http://www.dinf.ne.jp/doc/english/Us_Eu/conf/tide98/114/engelen_jan.html)

<sup>32</sup> Harry Knops, "Assistive technology on the threshold of the new millennium".

<sup>33</sup> <http://www.euain.org/>

### 9.2.1 Ebrass

The eBRASS project consisted of a consortium of 5 partners (UICI, BIC, ONCE, DEDICON, KFKI) who were funded under the European Commission's eTen programme with the intention of realising a market analysis and validation of a possible future internet-based trans-European service which would see an on-line library hosting Braille electronic music texts to be downloaded and used by non-sighted musicians thanks to an appositely created software (Braille Music Editor). The project created a demonstrative small online library catalogue and this was widened and enriched with some Braille music scores selected on the basis of the tastes and needs of Portuguese, Spanish and Italian end users (the project's market validation phase took place in these countries). Thanks to the BME software, visually impaired musicians and music students are in a position to exchange scores, modify existing files and create their own pieces of music to circulate on the web, in accordance with the common rules laid out by the New International Manual for Braille music Notation.

### 9.2.2 Contrapunctus

The Contrapunctus project built on the eBrass project, by:

- creating BMML code such that similar provision of scores can take place in a more interchangeable and non-proprietary format.
- looking at different models of presenting catalogues online for distribution of accessible Music scores.

MUS4VIP can benefit from the results of the Contrapunctus study by taking into account:

- the possibility, using the Contrapunctus BMML code and software to explore scores interactively;

- the integration of the reading/editing program with existing music notation software packages such as Finale or Sibelius.
- The possibility of using the Contrapunctus catalogue for retrieving and downloading scores.
- The possibility of using the Contrapunctus software to transcribe printed scores into Braille music files (also based on scanned printed music).

### 9.2.3 i-Maestro

This project aims to explore novel solutions for music training in both theory and performance, building on recent innovations resulting from the development of computer and information technologies. These solutions are created by exploiting new pedagogical paradigms with cooperative and interactive self-learning environments, gestural interfaces, and augmented instruments, with computer-assisted tuition in classrooms to offer technology-enhanced environments for ear- and practical-training, creativity-, analysis-, and theory-training, ensemble playing, composition, etc.

In achieving the above aims, some activity was done in the area of Accessible Music pedagogy, in developing Accessible Music additions to the learning tools being created as part of the I-Maestro environment. In doing so, an overview of Accessibility Aspects in Music Tuition was available from the I-Maestro website. The developments in I-Maestro point towards a bridging of the gap between music pedagogy and music technology, and as such its developments are of interest to the MUS4VIP project in looking into ways that technology can aid the improvement of Braille music learning.

### 9.2.4 The Interactive Music Network

The main idea of the Interactive Music Network is to create a community to bring the European music industries and content providers in the interactive multimedia era. This becomes possible by putting together research institutions, industries and experts, achieving the critical mass required to reach the unique objective of studying and defining multimedia music modelling and coding for the new age.

Within the Music Network, the consortium chaired a working group on Accessible Music which was very important in raising awareness of the needs and requirements of the work in the area which MUS4VIP now tackles.

Two important outcomes of the Music Network project for the MUS4VIP project were the creation of an MPEG group on Music notation and the setting up of the network as a legal entity.

The Music Network created an MPEG Ad Hoc Group on Symbolic Music Representation<sup>34</sup>. ARCA's work in this group involved the integration of accessible music notations within the forthcoming music notation standard within MPEG.

### 9.2.5 Accessible music maker

In 2003 the Dutch library Dedicon developed a new approach to producing Accessible Music. This software allows transcribers to take advantage of the music editor Finale in order to produce music in alternative and accessible formats.

The Accessible Music Maker is a software tool that can be used as a plug-in for the Music notation program Finale. With this plug-in, a Finale music file can be exported as a music Braille score (following the rules as set by the New Interna-

---

<sup>34</sup> <http://www.interactivemusicnetwork.org/mpeg-ahg>

tional Manual of Braille music Notation). This score can be embossed and read by a visually impaired musician.

The plug-in can also produce a talking music book in Daisy format of the same Finale music file. This talking music book presents the music score as a series of played music fragments, followed by a detailed spoken description of all the items in the music score.

The Finale plug-in produces a fixed format Braille or spoken content. However, transcribers and users will always have the need to make changes, additions etc. to their scores. It was recognised as highly important that these kinds of conversion tools come with an editor that would enable transcribers and other users to fine-tune their scores.

At the present time this plug-in is unfortunately no longer in development.

### **9.2.6 Play2**

The Play2 project (which was the predecessor of the eBrass project) had established a musical, multimedia Braille library called Dodiesis and a Braille Music Editor (BME). The BME editor is fully accessible to blind users and can be used to write, read and listen to Braille music scores. The Braille Music Editor can also be used by sighted transcribers to produce Braille music scores. The library as well as the editor was available at [www.Dodiesis.com](http://www.Dodiesis.com) but later on they became part of the eBrass project and are now available via the eBrass website at [www.ebrass.org](http://www.ebrass.org). The electronic music format is the PLAY Code that is no longer being developed.

During the project special attention was paid to the integration of the BME editor with the Finale music notation software, resulting in a plug-in for this program. With this plug-in, Finale files can be converted into Braille music files and vice versa. The principles behind the Finale plug-in that was developed for the Acces-

sible Music Maker and the one developed for the Play2 plug-in are the same. The main difference is that the Play2 plug-in can convert music Braille files into (visible) Finale files as well and that the music Braille files produced can be edited after they have been produced.

### 9.2.7 Wedelmusic

WEDELMUSIC was an innovative project to allow the distribution and sharing of interactive music via the internet respecting the publishers' rights and protecting them from copyright violation.

The WEDELMUSIC project, which ran from 2001 to 2003, was initiated to allow publishers, archives and consumers (theatres, orchestras, music schools, libraries, music shops, musicians) to manage interactive music; that is, music that can be manipulated: arranged, transposed, modified, reformatted, printed, etc. The same musical items will be available for traditional media as well as in Braille. This was done within a secure environment that respects copyrights.

The results of the project were:

- an XML-based format for modelling music;
- reliable mechanisms for protecting music in symbolic, image and audio formats;
- protection technologies for secure delivery of music;
- viewers, players and analysers for sighted and blind people for reproducing music in the new format;
- tools for distributing music via the internet and managing music in libraries, music schools, etc.

The system development activity in the project was devoted to defining the WEDEL Model and Language for music distribution, watermark algorithms for images of music scores, watermark algorithms for audio files, watermark algo-

rhythms for symbolic music in print, and encryption/decryption solutions for protecting digital music in all its formats.

### 9.2.8 Harmonica

Harmonica (1997-2000) set out to improve access to music collections in libraries of different types, taking into account the needs of various groups of users in the evolving world of networked information and multimedia. Its aim was to provide a solid strategic framework for networked access to music and related multimedia services, including technologies, existing and emerging standards, exploration of network options and improved interfaces.

Three working groups focussed on the libraries (how they organise information and make it available), the users and potential users (how they use music libraries and what they expect to get from them) and on technologies of recording and preservation. These working groups gathered information and opinions about these issues.

The project ended in a series of recommendations concerning further research on:

- In-depth survey of users' needs (behaviour, search patterns, expectations) in the music library and on the internet.
- Developing the domain of Music Information Retrieval (principles, methods and tools).
- Ensuring maximal interconnectivity between music libraries with a minimal set of constraints (standards, translation tools...): research into a minimal "core" of standards to allow such interconnectivity.
- Defining recommendations for publishers to include computer readable metadata in their products (books, scores, CDs...) and on the network, with a proposed standard.
- The library could become one of the commercial outlets for the music industry and publishers, for the exploitation of its collections. Internet guidelines

should be established by which libraries should allow users to download music from the internet and record it on CD-ROMs, the library being empowered to levy costs payable to the appropriate rights collections societies.

The information and recommendations of Harmonica helped shape ideas that succeeding projects, including MUS4VIP, can incorporate and build on.

### 9.2.9 Miracle

In 1996 the New International Manual of Braille music Notation was published. In the following year the Cantate project produced a system which linked music catalogues and databases of digital scores. It was natural to bring these two ideas together to build a central, on-line library of music in alternative formats. This resulted in the Miracle project (1999-2001), supported by the European Commission Telematics Applications Programme.

The main aims of this project were:

- To develop a system whereby special libraries can have access to and download Braille music (and other formats including talking music and large print music) in digital form from a central database.
- To enable these libraries to make the most efficient use of the expertise available.
- To reduce costs and duplication of effort.
- To enable these libraries to contribute their productions to form a shared resource.
- To establish common standards for production and where national presentation standards differ to keep variations to a minimum.

At the moment the central catalogue is no longer on-line.

### 9.2.10 Braille Score

It is worthwhile to mention one of the Polish projects in the area of Braille music accessibility. This was carried out by the Systems Research Institute of the Polish Academy of Sciences between 2009 and 2012. The main objective was to design an application, *Braille Score*, enabling music conversion between such formats as printed music, Music XML, Braille music and MIDI, *Braille Score* being a computer system for processing music information for both sighted and blind users. A prototype application has been developed. The conversions are performed with the use of internal music data representation format. The application makes it possible to edit the music information available or to create new information from scratch (i.e. compose music) and convert it to any of the formats mentioned above.

The Edwin Kowalik Music Society collaborated with the project as a Braille music consultant. The results of the project can be seen at the website:

<http://braillescore.ibspan.waw.pl/>

The Systems Research Institute is willing to cooperate to further develop special Braille music related software.



# 10. Analysis of the results of the EU project Contrapunctus: copyright problems the braillemusic.eu web library

## 10.1 Analysis of web portal

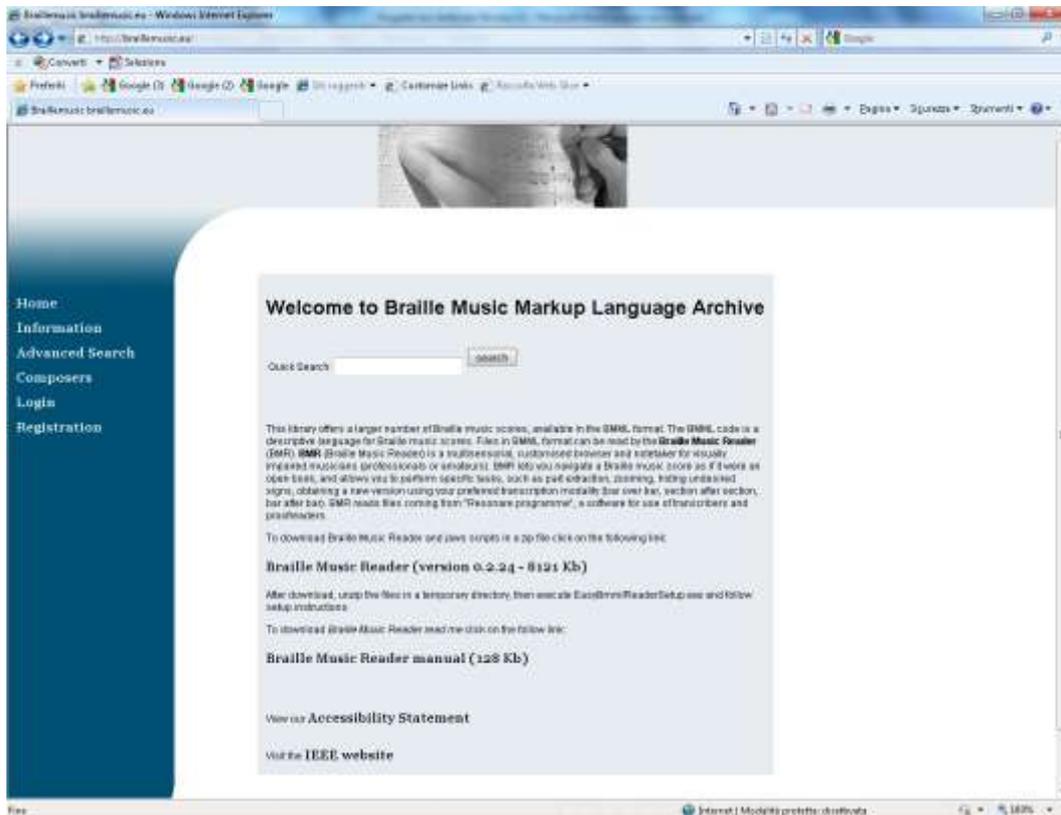


Figure 28: Home page for the portal [www.braillemusic.eu](http://www.braillemusic.eu)

The expectation of substantial economic advantages and improvements in quality for end users, arising from the use of information technology, the BMML format and the implementation of tools and useful solutions for the digitisation and use of the available Braille music material (thanks to EU project *Contrapunctus* and the programs *Resonare* and *Braille Music Reader*), is surely one reason that suggested and promoted the initiation of services for online storage, cataloguing and distribution of electronic format Braille music texts. To this purpose, an online library model has been planned and subsequently made by ARCA Projects Ltd, available on the "www.braillemusic.eu" web portal. The intention was to generate interest from both institutions and associations dedicated to the training of young blind people and national Braille libraries, which will be able to promote and share archives and catalogues with other institutions.

## 10.2 Problems with the use of accessible information

For those people afflicted by serious sight problems, the availability and possibility of production of Braille books, newspapers, magazines, textbooks and music books is not that big. Indeed, it is estimated to be less than 1%, if compared with the availability of traditionally printed books, including musical scores<sup>35</sup>. Furthermore, the costs of obtaining a transcription of a required text are very high, and often involve very long waiting times.

This observation suggests that a focus on questions of accessibility should be present from the moment a published product is first planned. While, today, accessible texts are created from time to time, using various transcription forms and methods from original versions, the fact remains that most formal, educational and teaching texts were originally designed for sighted users and, therefore, in some cases they may not be in full compliance with the training needs of blind or visually impaired users.

---

<sup>35</sup> As reported in the "Contrapunctus" project.

In Europe, social services and special libraries are effective in supporting the needs of blind people in gaining access to information, but the services themselves complain that one of their biggest obstacles is the rigidity of the legislation currently in force on publishing rights.

For example in Italy, to use copyrighted material the person who makes the transcription requires the authorisation of the copyright owner, usually a publishing house (according to the law 663/1941), which normally requires a few months of waiting.

If the material is no longer covered by this right then there is no problem, but the question has to be solved when referring to all modern and contemporary literature, to newspapers, magazines and also any text that appears on digital platforms (CD-ROMs and websites, to mention the most common formats). It is not obvious that accessibility is guaranteed just because they are already available on such platforms, especially if the web pages use the, now common, graphical interfaces or coding that cannot be interpreted by screen-readers.

The right of access to this vast amount of material must obviously be the same for everybody without any additional waiting time (evidently so in the case of newspapers, for example). The lack of any guarantee of the accessibility of such content clearly justifies the visually impaired in using some form of transcription.

It is obvious that the direct and universal accessibility to the format in which each work is published can only be guaranteed by the house that produces it. At the moment when new editorial products are planned the needs of a particular category of buyers are not taken into account (perhaps due to the low impact they would have on profits, given their relatively small numbers). These potential buyers are seen as not economically justifying any further investments and the subsequent appeal for the intermediate step of product customisation then incurs additional costs for the user.

In addressing these concerns some alternatives are possible, but unfortunately they do not yet even seem to be perceived by the majority of the publishing

houses. The solutions might be of various types: the publishing house itself could directly produce and sell the work in an accessible format, as it does for its standard customers; the text could be made available with the appropriate education and teaching additions and adaptations; PDF files (a standard developed by Adobe) could be used in an accessible structure; audio-books (growing in popularity even among sighted people). Even more desirable would be the "Daisy - digital talking book"<sup>36</sup> dedicated format. These solutions, however, are still of very limited application.

The convenience offered by sharing texts via the internet as accessible files, immediately available and therefore giving no logistical problems (as opposed to travelling to libraries, sending book requested, archiving etc.), and downloading them directly to one's device, has led nowadays to the creation of web portals and databases intended for the visually impaired, often created or expanded by the users themselves in the name of the protection of their right to independent reading.

This kind of free file sharing is legal so long as the works made available are out of copyright; if not then the transcribed works must be made available through express agreement (and therefore almost always upon payment) to the publisher.

There is, however, a second obstacle that leads publishers to oppose this kind of service - the possibility that the digital file, due to its extreme accessibility can also be freely downloaded by sighted people who would simply appropriate the work without buying a printed copy. This constitutes a potential economic danger for the manufacturer. Measures to prevent piracy nowadays can never totally preclude theft. Once a file is online, it is impossible to be sure about its use.

---

<sup>36</sup> The "Daisy" format allows the user to "surf" the book, through connections (links) in hypertext, making its use similar to that of printed materials.

In 1996 was formed the consortium "Daisy" by Sweden, The Netherlands and Great Britain to study the various modes of production, storage and use of digital talking books.

### **10.3 Texts for blind people: the European legislation**

In 1996 under the WIPO (World Intellectual Property Organization) two treaties were adopted: the "WCT - World Copyright Treaty" and the "WPPT - WIPO Performances and Phonograms Treaty".

The innovation introduced by these two treaties is to define specific rules designed for the dissemination of data in digital format. The "WCT" in particular is part of the system created by the "Berne Convention".

It should be remembered that according to art. 5 data compilations too, in whatever form they exist, are (thus including digital data-bases), are considered as intellectual creations and so they are protected, of course without prejudicing authors' rights over any material contained in the compilation.

Looking more closely at European legislation, the main international obligations deriving from the "WCT" treaty were transposed to the Commission Directive 2001/29/EC.

While protecting works, this Directive aims to "promote learning and culture by allowing certain exceptions or limitations, in the public interest for the purpose of education and teaching". In the case of copying a work an indemnity for the author is scheduled, and the files copied must be for private use only. To avoid member States introducing too general exceptions, a separate exhaustive list of the possibilities has been drawn up.

We are here interested in this directive since it rules the DRM (Digital Rights Management), including obligations relating to effective technological measures to be taken to control the reproduction and dissemination of copies via computers.

Special exceptions are reserved for libraries and archives, for useful material for educational and research purposes, and in the interests of disabled people.

As for libraries, their problem is about the production of digital copies of materials and its provision to users, including online users. For research or private study these materials can be available in the premises of the Institutions only, through the use of dedicated terminals.

For the benefit of disabled people, as mentioned above, the Directive provides for an exception to the reproduction and communication rights to the public. This exception was accepted by all member States, although in some jurisdictions it is applied to some categories only. For rights holders a fair compensation is provided, and it is mandatory in Germany, Austria and the Netherlands.

**In Italy**, decree n. 239 published in the Official Gazette of the Italian Republic no. 295 of 20/12/2007 (implementing regulation the law 669/1941) talks of "the sensory disability" and, besides allowing the reproduction of works and protected materials on audio or other devices suitable for reading by the visually disabled, quotes law 4/2004, which regulates the possibility of transformation of contents in electronic formats accessible through assistive technologies. Rights holders are also required to adopt appropriate solutions, even through agreements with associations of category, to allow the exercise of exceptions on the request of beneficiaries, provided that they have acquired the lawful possession of the protected materials, and paid for them where appropriate.

**In the UK** The Copyright (Visually Impaired Persons) Act 2002, which came into force on 31 October, 2003, amends the Copyright Designs and Patents Act 1988. Its purpose was to remove the key difficulty experienced by those seeking to make information accessible - the need to seek prior permission and the resulting delay - whilst preserving the legitimate rights of authors and others. Thus the Act introduces exceptions to copyright law which, in general terms, remove the need for anyone to obtain permission from the rights holder to produce an "accessible copy".

One strength of this law is its functional definition of visual impairment.

"A visually impaired person" is defined broadly, as a person

- who is blind;
- who has an impairment of visual function which cannot be improved, by the use of corrective lenses, to a level that would normally be acceptable for reading without a special level or kind of light;

- who is unable, through physical disability, to hold or manipulate a book;  
or
- who is unable, through physical disability, to focus or move his eyes to the extent that would normally be acceptable for reading.

Thus it goes beyond "blind and partially sighted" people, as commonly understood, although it does not encompass people with perceptual or cognitive disabilities, such as dyslexia.

Another strength of the Act is that it focuses on accessibility rather than specific formats.

"An accessible copy" is defined as:

- "a version which provides for a visually impaired person improved access to the work."
- "An accessible copy may include facilities for navigating around the version of the copyright work...", so it covers hard and soft copies - i.e., Braille, audio, e-text, large print etc.

The Act covers "Any literary, dramatic, artistic or musical work" not accessible to a visually impaired person in its original form. "Musical" here refers to sheet music, not to performed or recorded music.

There are two parts to the new Act: One-for-one copies and multiple copies.

#### *One-for-one copies*

If you are visually impaired, you can make, or ask anyone to make for you, a single accessible copy of anything of which you have "lawful possession" or "lawful use". This can cover anything that you have bought, been given or lent, or that is held in a library that you are eligible to use. It covers material published commercially but also other material made public, such as dissertations lodged in a library.

Once you have got your accessible copy, you can pass it to others who qualify as "visually impaired", to the same extent that you would be able to do with the print

copy, as long as you pass the print copy with it. Equally, you can pass original and accessible version back to a librarian or teacher, who could later issue them to another eligible person.

The governing principle is that the original print copy remains with any accessible versions, so that only one person can "read" the work at any one time, as with print.

*Obligations and limitations with "one-for-one" copying*

The right does not apply if an equivalent accessible copy is already available commercially. The accessible copy must carry "sufficient acknowledgement" of its source, such as title, author, and edition and it must carry wording to indicate that it has been created under the terms of Section 31A of the Copyright, Designs and Patents Act 1988 as amended by the Copyright (Visually Impaired Persons) Act 2002.

*Multiple copies*

Multiple (two or more) accessible copies can be made by any not-for-profit body and any educational establishment. The Act refers to these as "approved bodies", but no approval process is required.

Generally, files for producing accessible copies, known as intermediate copies, can be transferred between one approved body and another. However, an educational establishment has, under the Act, to ensure that copies will only be used for its own educational purposes.

**In Poland** copyright is governed by the law adopted on February 4, 1994 (with later amendments). Art. 33<sup>1</sup> allows the use of any works already published for the benefit of disabled people, if the use is directly adapted to the disability, if it is non-profit and if it is undertaken in the size resulting from the nature of disability. On the basis of the above stipulations Polish publishers of Braille materials and talking books or magazines feel free to use the source materials free of charge. In certain, though rare, cases, as a result of individual negotiations, they get the elec-

tronic source material from the publishing houses, which facilitates adaptation to the Braille system.

In order to download talking books from the library, one has to become a member of the library by producing a document certifying one's disability. Unfortunately, international exchange has been forbidden due to the interpretation of the author's law as territorial by the Ministry of Culture and National Heritage. An international solution of this question, offered by WIPO treaty implementation, is really desirable.

Braille music has been ordered exclusively in the paper form so far. The main reason is a lack of an accessible music editor adopted as standard, easily accessible to the user and supported by consultants. Braille Music Editor seems to offer such a solution.

The Edwin Kowalik Music Society is the only publishing unit in Poland dealing with music transcription. Music transcription into Braille is usually done at individual request and the users are charged very little for this service. The catalogue of pieces transcribed is accessible on the internet, so that other blind musicians can take advantage of the music already prepared in the Braille format, thus avoiding long waiting times. The Edwin Kowalik Music Society has also made an attempt to promote some Braille music in electronic form, namely a choral music library which was launched on the Internet, providing blind users with access to over 300 pieces. One of the formats is a Braille transcription in the txt format. Blind users can order a Braille copy of the pieces they need.

As for the diffusion of works for teaching and research purposes, the national legislations of the European countries are often restrictive: distance learning or home-based learning via the internet are not taken into account.

A step forward in this direction was, however, taken at a European level with the "IPRED 1" Directive (2004/48/EC). This Directive states that it is not considered a crime to reproduce any media for the purposes of "criticism, review, information

and teaching, study or research". The expropriation of intellectual property is therefore possible in the public interest.

In 2007 the "Charter of Fundamental Rights of the Union" (CFRU) was approved and in art. 17 property rights are discussed. The article specifies that the only reason why a person may be deprived of their property rights would be for the "public interest", acting, however, always in the manner prescribed by law and with adequate compensation. The intellectual property remains protected anyway. In the "CFRU" this specification was absent.

In recent times (November 2008), following the development of legal offers of online cultural contents and the search for ways to counteract digital piracy, the Council underlined that the lack of interoperability and transparency between the protection systems of personal data and the protection systems of digital rights constitutes for consumers an insecurity and a limiting factor in the use of the proposed contents.

So, at Community level, the author's moral rights are currently still governed by the article 6a of the Berne Convention as amended by the Act of Paris of 1971.

The adaptation right is one of the exclusive rights, and it is part of the patrimonial prerogatives.

#### **10.4 Customs and practices in Europe**

Perhaps because of the difficulty and complexity of the practical application of European and national laws on copyright, a kind of self-regulation has arisen. This, in a very fragmented and uneven way, has led each country to consolidate some customs and practices.

In the case of a blind person who wishes to access certain musical texts, he/she can adopt various solutions in different contexts:

- the purchase of a copy in print from which they then commission a transcription (either free of charge or on payment)
- the supply of materials through services or trade associations

- the use of libraries or specialized centres.

In such a regulatory environment, to understand how the processing of texts for disabled users is structured, a survey was conducted within the European *eBrass* project. The aim of the research was to collect data on the existence and consistency of practice of the exception to the Copyright laws, operational customs for the supply, in particular, of music texts in accessible format. To this end, a questionnaire was distributed in many European Countries by contacting libraries, music archives, centres and transcription services, as well as music publishers, Braille publishing houses and blind users' associations.

The result of the survey showed that the most commonly adopted solutions for the supply of accessible copies of printed texts seems to be the direct transcription into Braille and to an increasing extent also in Daisy format. The Braille paper version reassures publishers, as they are aware that the format is solely dedicated to blind people and cannot be reused for other purposes.

Usually the transcription centre asks for the publisher's permission directly as well as dealing with the signing of all necessary agreements, if the work is still protected by copyright. Publishers, even in the presence of restrictive regulations, rarely oppose this because the transcriptions are targeted at disabled users and copies are intended for personal use only. Sometimes they ask the end user to purchase a copy of the printed text.

As the Contrapunctus project survey confirmed, almost all of the laws of European States make an exception to copyright for disabled users, provided they remain the only recipients of the transcribed work.

The copyright protection for a text required abroad is often considered to be an additional problem, because the specific national laws on the use of the material abroad seem to be little known and poorly enforced.

In general, the Contrapunctus project survey at European level shows only a low percentage of users expressing complaints to publishers, mainly complaining that there is a certain indifference towards the requests to have materials for Braille

productions and transcriptions, while on the other hand the publishers interviewed say they cannot directly manage the user requests, citing personnel limits for a sector that is basically considered a niche market, as well as demonstrating a lack of knowledge of the procedures for turning a text into Braille.

A significant fact to have emerged from the Contrapunctus project questionnaire is that only 9% of the transcription centres or specialised services or cooperatives responsible for the transcription of lyrics, claim to have direct agreements with publishers. Normally, the music text that needs to be transcribed is provided by whoever requests it, while agreements with publishers are necessary in the case of production started on the initiative of the centre itself.

Given the costs and the time needed for the production of a Braille music text, it is clear that transcriptions are requested by users only if truly necessary and when they have no other means to read and/or study a music text.

The Contrapunctus project survey has also analysed the dissemination of electronic Braille music texts and reported that essentially, in Europe, there is no service or centre that offers music material in this format, to be read in Braille using a Braille display or a printer.

The reasons highlighted by the survey are of various kinds: the first is of a regulatory kind, since the limits permitted by the publisher do not necessarily also cover the distribution of the electronic format, but only the paper one, and besides the publisher him/herself might have stipulated agreements with the author only for the paper distribution and not for the electronic format delivery. The second is substantially more important because it is economic. In practice, a transcription centre tends to preserve its own materials and only to distribute the Braille embossed, and not the electronic version that can be widely and easily distributed, and reused, in an uncontrolled way. Another factor related to the correspondence between Braille signs and alphanumeric characters, which is usually connected to tables locally in use.

## 10.5 Possible solutions to copyright issues: Italy

The most important element to consider in the planning phase of an online distribution of music scores is the possibility of ensuring some homogenous conditions for the distribution and compliance of copyright and of the standards that unfortunately in Europe are subject to the different national regulations.

Taking advantage of the research developed by the *Contrapunctus* and *eBrass* projects, with particular reference to the survey carried out on copyright problems, it is now possible, both nationally and internationally, to suggest solutions that can legally be adopted in Europe.

The possible copyright infringement is a factor that has already been brought to the public attention in Italy, in 2000, when the "Galiano" Foundation and the "Cavazza" Institute, both online service providers for blind people, had a serious legal dispute initiated by a group of publishers who held the copyright on the freely available material on their sites.

Although the text files were designed to facilitate access to information for blind users via computer aids, and were transcribed for strictly personal use only, the same files were actually available to anyone through the internet, including sighted users who could obtain, through these sites a "free" version of a work without buying a printed copy.

According to Beduschi, the lawyer acting on behalf of Mondadori, the growing presence in the market of legally published works in electronic format, with the possibility of listening through speech synthesis, has excluded any justification for the unauthorised reproduction in electronic format of protected works.

The accused parties argued that, in this case, the law on copyright contravened the right to equality among all citizens, enshrined in the Constitution. At that time the works in digital format on the market were not always fully accessible. It was clearly inadmissible to ask that blind people should limit themselves to works that were already out of copyright or already published in electronic format. Such a

request would put them in a clear situation of discrimination in comparison with sighted users.

At the end of the litigation, the parties entered into an agreement involving the library "Regina Margherita", the AIE (Italian Publishers Association) and the UICI (Italian Union of Blind and Visually Impaired people), which authorises the library to transcribe works to make them accessible to the visually impaired, but only in cases where the work is not already commercially available in a suitable format. The content is strictly for personal use only.

The solution adopted by the "Galiano" Foundation and the "Cavazza" Institute therefore becomes a reference for other similar initiatives and services and consists substantially in requiring of the online library users a registration with a valid document attesting to their visual impairment. It also clearly states the terms of use of the works in the database: they only enable the visually impaired access to culture with the same autonomy as a common user of printed text, without any advertising or profit purpose. It is also reported that many texts were transcribed from very cheap editions, for which the appropriation by sighted people of the free file intended for Braille reading would be even more difficult and counter-productive than buying a printed copy.

It is important to emphasise that no additional security tool was added, for example, to avoid the possibility of transferring digital texts from an authorized user to other unauthorized users, and that the registered works have been transcribed with permission of the respective publishing houses, notwithstanding the rules in force, and as an alternative to the usual commercial channels for distributing books.

## **10.6 Possible solutions to copyright issues: Poland**

In Poland there are at present over 10 small institutions involved in the adaptation and printing or recording of various kinds of materials for the visually impaired. The central printing house and recording studio of the Polish Association of the

Blind, which for many years had been the main provider of materials for the blind, is in decline and cannot serve as the reference institution i.e. the one developing and negotiating the standards to be followed on the national scale. In this situation every publishing unit has its own policy, but basically adopts the national law on copyright of February 4, 1994 (with later amendments), particularly art. 33, based on the interpretation of its lawyers. This interpretation is basically favorable for the visually impaired. However, in view of the fact that the national legislation is binding within the country, neither Braille nor talking books can be distributed abroad nowadays. The exchange will become possible among the countries that ratify the WIPO treaty and our great expectation is that this will happen soon.

### **10.7 Possible solutions to copyright issues: UK**

Any solutions to copyright will be based upon the Copyright (Visually Impaired Persons) Act 2002, mentioned earlier in Section 9.3 and the eventual ratification of the more recent WIPO treaty.

One issue that has been identified in relation to the Mus4VIP project is that the use of the technology and specifically the MusicXML format makes it potentially easier for sighted users to reconvert scores created for blind users back into print music. When musical scores are transcribed into embossed Braille scores it is obvious that these are only useful to blind users and there would be no easy possibility of reconvert them to print. With a score created in Braille Music Editor the music can be exported in MusicXML format and a sighted user could then import that file into a notation package, e.g. Sibelius or Finale, and have a useable score. The situation for music then becomes more analogous to the issues that arise with e-books and this is something which will need to be addressed in any system for making music available to blind and visually impaired users.

We note that in the solution adopted by the "Galiano" Foundation and the "Cavazza" Institute, to the dispute over e-books in Italy, no security tool was

added to avoid the possibility of transferring digital texts from an authorized user to other unauthorized users. No such tool is currently available for the bmml format for music Braille and so publishers will have to be reassured that there is minimal risk of copyright infringement as a result of making their scores available in this form. If they cannot be so reassured then the need for a security tool may arise.

### **10.8 The Braillemusic.eu web portal: description**

The final activity of the "Contrapunctus" project was to create a demonstration model of an online service of collection, storage and distribution of Braille BMML music scores throughout Europe. To do this, a web portal was created, in order to see the catalogue and downloading files. Also attached were a set of possible scenarios for its use.

The web portal was made in accordance with the indications of the W3C accessibility, also taking into account the European guidelines on copyright and subject to the regulations of the countries participating in the Contrapunctus project.

All available material on the demonstrative web portal is currently free, and the service offered is of a not-for-profit kind. It is uncertain if the service now available should remain totally free, since there is the possibility of distributing copyrighted material, for which a payment to the owner of the rights would be required.

Since there are copyright exceptions provided for disability, it is first of all required of each user that they declare their status and role in the registration phase (teacher, student...).

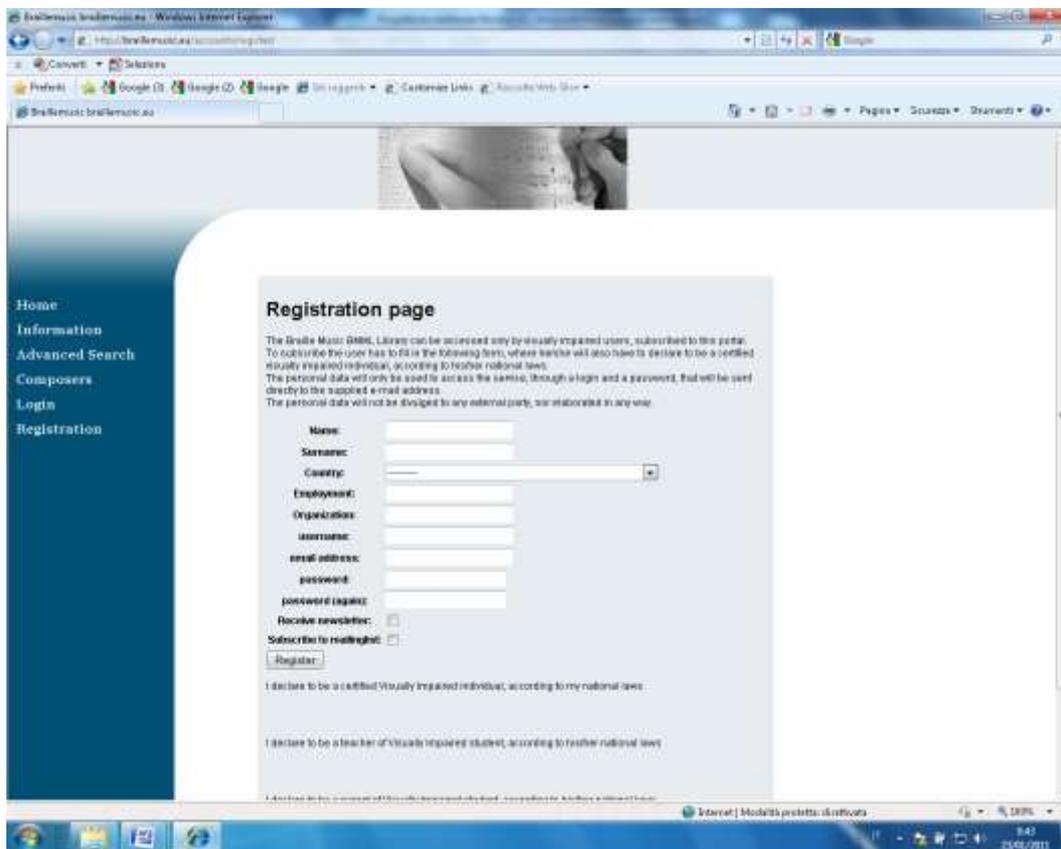


Figure 29: Registration page on the www.braillemusic.eu web portal

The contents available to the registered user are divided into three categories.

The first category includes freely distributable materials (transcribed from free editions), works no longer covered by Copyright either due to the expiry of the protection period fixed after the author's death, or because it has made available by the owner with a "Creative Commons " license (thus only some rights are reserved), or because the publisher has freely chosen to receive no payment for the distribution of Braille format material intended for visually impaired people.

The second category includes scores only available for users from the country in which the transcription/revision has been done. If users wish to download a file from another country for which they do not have the required rights, the system displays a notice inviting them to contact the copyright owner of the chosen content directly.

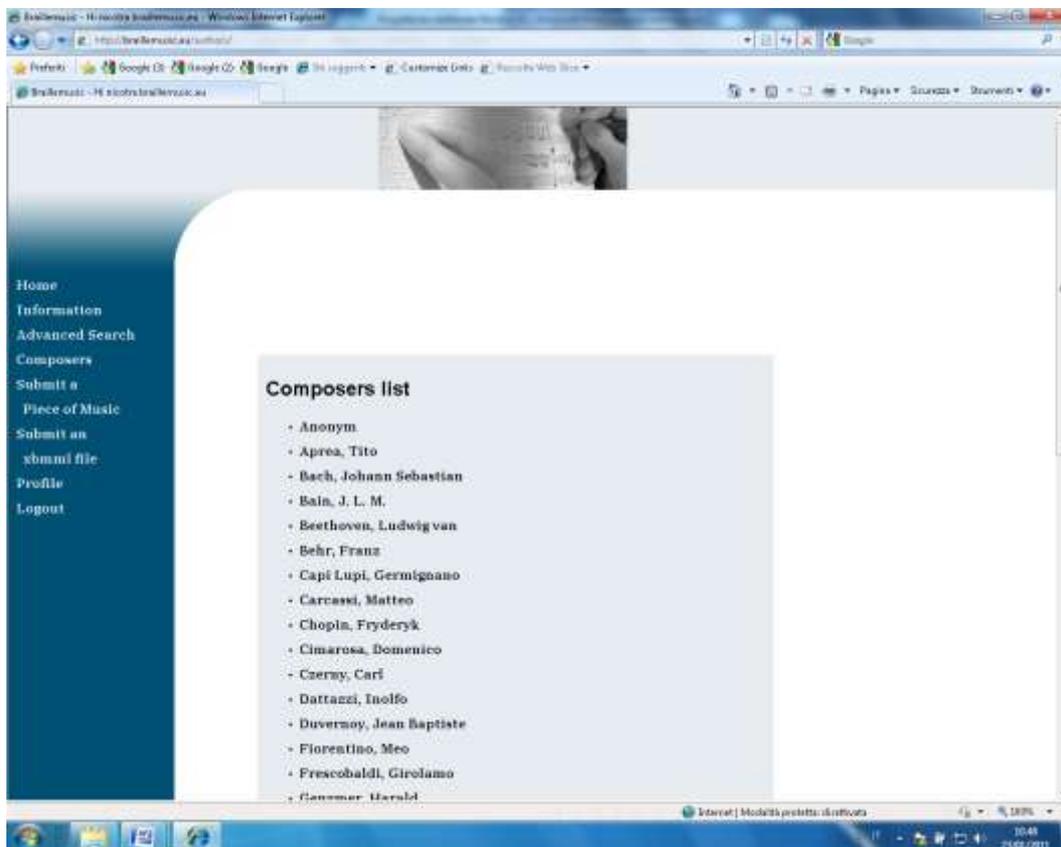
The third category consists of all the material currently still covered by law, for which distribution is not possible. The user must then purchase paper or digital copies directly from the supplier. This category was adopted in view of the possibility, should the demonstrative prototype be adopted by a Braille library, that the portal might also offer an e-commerce service.

A supranational distribution can then be operated by verifying for each user, through his/her profile, the country of residence, the copyright status of the requested material in that country and the geographical location of the libraries that have provided the material. It is those libraries' task to identify the correct category and the rights terms, especially if a text has been copied, transcribed and digitised without asking the publisher's permission but just on the basis of national rules which are only valid for users in the same country.

### **10.8.1 The Braillemusic.eu web portal: How to search**

Once the user has logged in, a search of the contents is permitted.

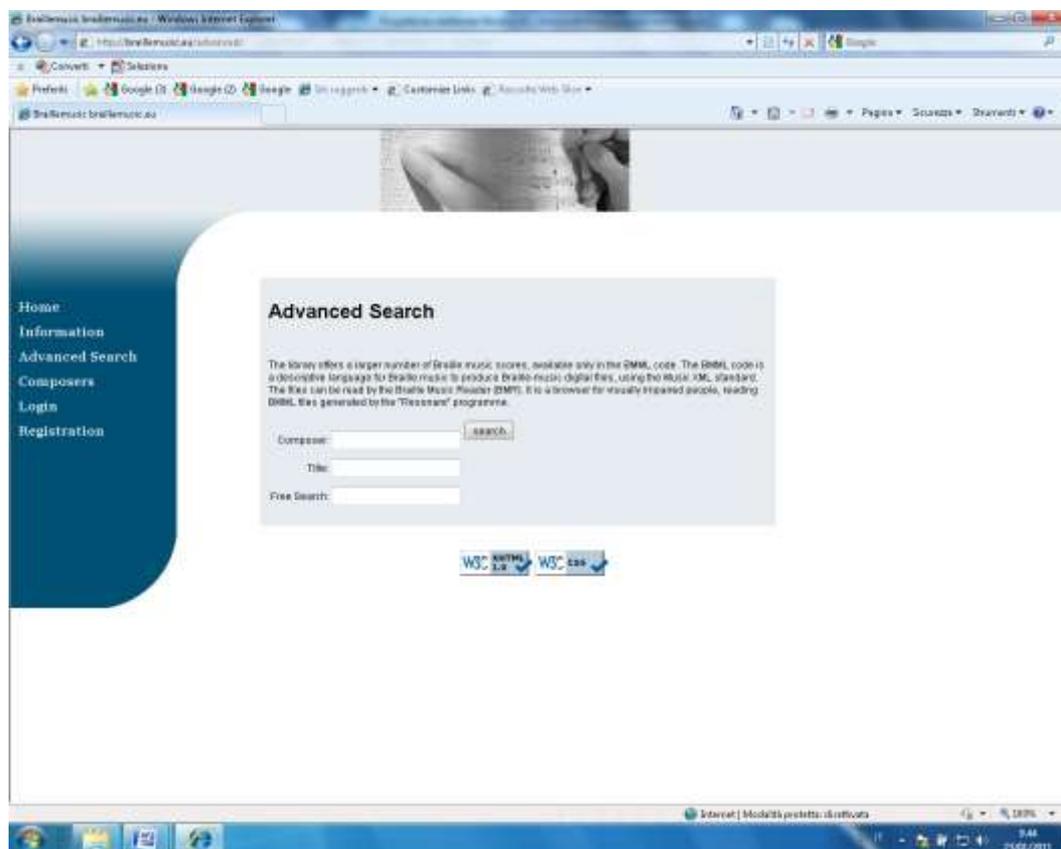
It is possible to open a page containing a list of all the composers that are in the archive: by selecting a name a page that lists all the works of that composer will open up.



*Figure 30: List of composers into the archive*

Another way is offered through a dialogue box that allows you to search all the fields of the archive. The third mode is the advanced one which has three search fields, divided into subfields. The first field is devoted to the identification of the author, including transcribers and proof readers, and the system has been equipped with a list containing the different graphic conventions for indicating names. The second field allows a search by title (or part of title) of the work; the names are listed in accordance with the "New Grove Dictionary of Music and Musicians". The third field is more generic and allows a search of all remaining information apart from composer and title, e.g. instrument, genre, source (library or user who made the material available), country of the Braille score, Braille format used ("measure on measure", "measure after measure", etc.).

In each of the three main fields the Boolean "and" operator may always be used.



*Figure 31: Advanced search page of the web portal*

After clicking the "Search" button, a list of results will be displayed in order for the user to select the desired piece and see a full description of the score. The BMML file can be downloaded by clicking on the related link, in accordance with any copyright restrictions.

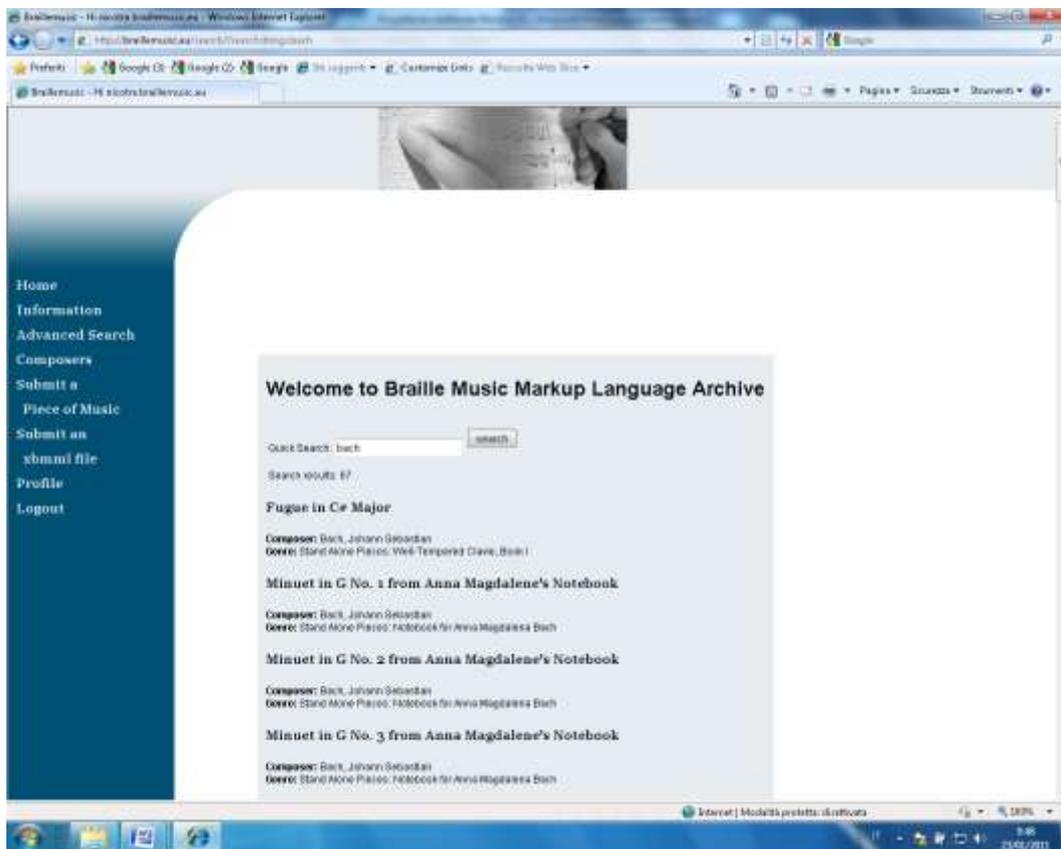


Figure 32: Page showing search results

Registered users may download scores and, if allowed, they may also upload their own BMML music files. If a user wishes to contribute a BMML file, the system allows the manual addition of the related metadata.



Figure 33: The page that allows the user to upload a file

## 10.9 Conclusions concerning problems of copyright

From the surveys undertaken in the *Contrapunctus* and *eBrass* projects - investigations into the use of Braille music scores transcribed by the major European and non-European production and distribution centres - we notice that the main difficulty is that of combining, at a practical level, the rights and interests, on one side, authors and publishers, and, on the other, users and consumers with visual impairments. These groups have standards for their protection incorporated in the laws of the western European countries.

In fact, if on the one hand there is the risk of encouraging piracy by offering material in the form of uncontrolled digital copies, not subject to restrictive regulations

then, on the other hand, it may be seen that legislation can also be a useful tool for integration and independent access to information for people with visual disabilities.

The *Braillemusic.eu* portal aims to reconcile these two divergent interests within the current market environment. Products offered commercially are targeted at the most profitable market sector, that is to say the normally-sighted users, and this is to the detriment of the small percentage of disabled readers who are, in effect, excluded from enjoying these products. Conversion into different formats and the establishment of mechanisms for the controlled exchange of materials (whilst respecting the copyright and usage of these materials) must, therefore, be considered an entirely legitimate practical solution, in the present situation where visually impaired users are clearly disadvantaged. This objective is easily achievable thanks to computer technology, but it is not the definitive solution to the problem.

The model developed by *Braillemusic.eu* therefore places great emphasis on the possibility of operating in a totally new way, thanks to proposals that affect the core of the creative process. This involves the use of a common digital format, to be used in the same way by sighted and blind people for the management of music files, while remaining flexible and customisable to the needs of individual end users. This approach would eliminate discrimination in the enjoyment of products and, at the same time, constitute a manageable system in full compliance with copyright laws.

The application of this principle on a large scale - for example in publishing, with the commercial use of genuinely accessible digital formats, in a uniform way and for any type of user - is still, at the moment, limited and fragmentary.

The proposal designed by the "*Contrapunctus*" project, as well as providing a usable solution for a small minority of users/consumers, may also constitute one of the many steps forward in awareness of the problem of information accessibility. It highlights the principle that a solution should not be sought in the simple "adaptation" of the existing work, but rather that provision for multiple needs should be

a part of the original planning. It is necessary, from the outset, on both the scientific and the practical level, to plan for the specific needs of individual groups of users/consumers.

Finally, it should be noted that, if it is true that the trend towards globalisation is connected with the standardisation of products, then it is equally true that celebrating diversity as a human value can be combined with the opening or expansion of niche markets. The diversity that is the *raison d'être* of such niche markets creates added value in economic terms as well.

## 11. Conclusions

As readers will undoubtedly have noted, this work is the result of long professional experience on the part of all the partners in the MUS4VIP project, in different sectors (contiguous, but specific) such as the teaching activity, the study of general accessibility issues and the specific tools for visually impaired and blind people. But it also arises from a civil commitment, to the principle of equal opportunity, genuinely practiced and not just preached.

We are profoundly convinced that a society modelled on the separation of cultures is destined to disintegrate. Although this model may have provided stability to different social strata for many centuries it has stifled the potential of the weakest, be they women, children or disabled people.

The reader will have no difficulty in tracing a thread that runs throughout the analysis of the state of the art, which presents, from an unusual point of view (access to music studies), an important part of the path of emancipation and self-emancipation of a social minority - the blind minority that has always been pitied by the "healthy" society.

The history of Braille music notation is, in this sense perhaps a paradigm for the strengths and contradictions innate in any human progress.

In fact, if the school structure based on the segregation of blind students marked the acme of musical culture among blind people, it also contained within itself the inconsistencies that brought about its abolition towards the end of the Sixties, under the principle of equal opportunities and of inclusion, first in school and then in society.

But, still following the thread of the story of music studies, this new phase of inclusion soon showed its difficulties, especially when we witnessed (as we still do) the decay of one of the greatest strengths of the previous special educational system, which also coincided with a drastic decrease in employment, and, more importantly, the exclusion from the possibility of accessing the aesthetic experience of understanding music formally.

A closer look at the work shows a second contradiction, inherent in the technological progress which, if not guided by human intelligence and sensitivity, is likely to amplify the barriers that visual impairment inevitably involves. There is a considerable gulf between the opportunities for accessing formal musical education offered to normally-sighted students in comparison with those available to their visually impaired and blind peers. The dissemination of a teaching model based on visual interaction – with teachers, scores and instruments - is a serious obstacle for those blind people who want to approach music seriously and do not just want to learn by ear. The new technologies and research offer appropriate solutions to overcome this obstacle.

In the final section we aimed to demonstrate the success of the method invented by Louis Braille. This system, designed by a blind person for blind people, has often (even today) been resisted by educators, because they view it as a kind of barrier. Today, however, it stands revealed in all its potentialities, as computer technology sweeps aside so many of the difficulties that Braille music can present, especially to beginners.

Just as Braille was able to transform that awl<sup>37</sup> into his very first writing instrument (that same object which, at an early age, took away his sight in a tragic game), offering a new kind of sight to all blind people, so his method, initially marginalised by computer technology, has proven to be the most powerful means, in combination with computer technologies, of providing access to written music for those who cannot see.

---

<sup>37</sup> Awl, used by his father to work leather.

The fact that, despite any obstacles and difficulties, blind and visually impaired people continue to enjoy playing, singing, and making music, is the strongest encouragement to us to follow in the footsteps of Louis Braille, building upon his work of offering his fellows and all the blind in the world the means of accessing music in all its forms.. We believe that the idea of building a solution based on both the potentialities and limitations that derive from the lack of visual capacity could be the way out of the labyrinth in which music literacy is still imprisoned. Braille has proven to be the best means for blind people to access music directly and personally. IT technology, well used and well presented, can both harness the power of Braille and make it easier to learn and use.

We cannot close this report without stressing the complementary importance of study and practical application, thought and action, civil commitment and regulation, all of which contribute to the realisation of equal opportunities, in this case of access to musical culture. It is clear that this work can contribute to other areas, from education, to the use of services, to human relations.

Using a musical metaphor, perhaps a rather obvious one, we might say that this work is only a fragment of a larger piece, calling for the help of scholars, researchers, technicians, teachers and especially of those involved.

Will it have a sequel? This is the aspiration.



## 12. Bibliography

- Banchetti S., *Annotazioni di tiflologia comparata*, Bologna, Clueb, 1982
- Bellini, P. and Nesi, P., (2001). “Wedelmusic Format: An XML Music Notation Format for Emerging Applications” Proc. of the International Conference of Web Delivering of Music. Florence, IEEE Press.
- Biagioni Nicholas, (2003) *Storia del diritto d’autore*, Università degli studi di Brescia, Facoltà di Giurisprudenza, AA 2002-2003.
- Bizzi Vincenzo et altri, *L’integrazione scolastica e sociale dei bambini minorati della vista*, Torino, UTET, 1990
- Challis, B.P. and Edwards, A.D.N. (2000) “Weasel: A System for the Non-Visual Presentation of Music Notation”, in proceedings of ICCHP, OCG.
- Cotruvo, C. (2008) *Audio Music Description for Lead Sheet Music. Manual with CD*, No-C-Notes, USA.
- Crombie, D, Lenoir, R, McKenzie, N, (2002) “Accessible Music: Meeting the needs of the print impaired” in Proceedings 2nd Conference on Assistive Technologies for Vision and Hearing Impairment, University of Glasgow, UK.
- Crombie, D., Dijkstra, S. Lindsay, N. and Schut, E. (2002) “Spoken Music: enhancing access to music for the print disabled”. *Lecture Notes in Computer Science*, Vol. 2398. Springer-Verlag, Berlin Heidelberg New York.
- Crombie, D., Dijkstra, S., Lenoir, R., McKenzie, N., Schut, E. (2002). “Towards Accessible Multimedia Music” in proceedings 2nd International Conference on Web Delivering of Music, Florence, IEEE Press

Crombie, D., Lenoir, R., & McKenzie, N., (2005) "Accessible Music Technology for Print Impaired People", *Journal of New Music Research*

Crombie, D., Lenoir, R., & McKenzie, N., (2005) "Designing accessible software for music applications", in Hersh, M., & Johnson, M. (eds) *Assistive Technology for vision impaired and blind people*, Ch. 16, Springer-Verlag, Berlin Heidelberg New York

Crombie, D., Lenoir, R., and McKenzie, N., (2003) "Bridging the Gap: Music and Communication", *Proceedings Rencontres Internationales des Technologies pour la Musique (Resonances 2003)*, IRCAM, Paris.

Crombie, D., Lenoir, R., and McKenzie, N., (2003) "Producing accessible multimedia music" in *Proceedings 3rd International Conference on Web Delivering of Music*, Leeds, IEEE

Crombie, D., Lenoir, R., McKenzie, N, Ng, K. (2003) "Finding the Right Note: Making Multimedia Music Visible" in *Proceedings Electronic Arts & Visual Imaging (EVA2003)*, Institute of Archaeology, London, UK.

De Garmo Mary Turner, (1993) "Introduction to Braille Music Transcription" in *Addenda D-F*, Washington.

Guerrieri Natoli Isabella, *La scuola e l'alunno non vedente*, Roma, Sovera, 1998

Henri Pierre, *La vita dei ciechi*, Introduzione di Enzo Tioli Monza, Biblioteca Italiana per i Ciechi "Regina Margherita", 2000

Henri Pierre, *La vita e l'opera di Louis Braille: ideatore dell'alfabeto dei ciechi (1809-1852)*, Introduzione di Silvestro Banchetti, Monza, Biblioteca Italiana per i Ciechi "Regina Margherita", 2000

Krolick, B (1996), *New International Manual of Braille Music Notation*, World Blind Union, FNB, Amsterdam.

Krolick, B., (1975) *How to read Braille music*, World Blind Union, Amsterdam.

M. Recker, J. Dorward, and L. M. Nelson, (2004) "Discovery and Use of Online Learning Resources: Case Study Findings," *Educational Technology and Society*,

7 (2), pp. 93-104

Magliola, A. L'editoria tradizionale per i disabili della vista. Stato dell'arte e prospettive, Italia Pianeta Libro, n. 3,

<<http://www.ilpianetalibro.it/genera.jsp?id=790&l=it>> 2008.

McKenzie, C. (1961) "Outcome of the 1954 conference on music: decisions by the World Braille Council" New Beacon September 1961, 45 (533) pages 236-7

McKenzie, N, (2003) Talking Music Maker, International Projects Department of FNB, Netherlands.

McKenzie, N, (2003), User Manual - Using the Talking Music Maker with Finale, International Projects Department of FNB, Netherlands.

Mosterd, E. J., (1999) Developing a new way to transfer sheet music via the internet, University of South Dakota.

Nicotra G., Access to Music by Blind People, IST-Africa 2010 Conference Proceedings, IIMC International Information Management Corporation, 2010, ISBN: 978-1-905824-15-1

Nicotra G., Copyright and [www.braillemusic.eu](http://www.braillemusic.eu) on line music service, AAATE 2011 Conference, IOS Press BV, ISSN 1383-813X (print), ISSN 1879-807

Nicotra G., The new Braille Music XML format, International Symposium on Braille Music Notes del 13-15 novembre 2008

Reuß A., Systematik der Blindennotenschrift, Berlin: Verlag der Notenbeschaffungszentrale für Blinde, 1938.

Rodenburg, L.W. (1954) International Conference on Braille Music in World Council for the Welfare of the Blind, Paris 1954 pages 84-89

Rossi Dal Pozzo Francesco, (2009) Profili comunitari del diritto d'autore e dei diritti connessi nella società dell'informazione, Università degli studi di Padova, Facoltà di Lettere e Filosofia, AA 2008-2009.

Smirnov, G.A., (1999) Manual of Braille music notation, Monza, Braille edition.

Spanner, H.V. (1956) Revised international manual of Braille music notation.

Tiflogia per l'Integrazione, Rivista trimestrale edita dall'Unione Italiana Ciechi, Roma, 1990/2012

Vassio, G., (1984) Outline of Braille Music Notation, Monza, Italy, Braille edition. [or. title Compendio di notazione musicale Braille]

Vassio, G., (1990) Index of Braille signs, Monza, Braille edition, [Indice di Semiografia Musicale Braille].

## 13. Web Sites

AFB <http://www.afb.org>

BOOKSHARE <http://www.bookshare.org>

CAPELLA <http://www.capella-software.com/>

CAVAZZA <http://www.cavazza.it>

CNIB <http://www.cnib.ca/>

CONTRAPUNCTUS <http://www.contrapunctus.it/>

DAISY [www.daisy.org](http://www.daisy.org)

DANCING DOTS <http://www.dancingdots.com>

DBB [www.dbb.dk](http://www.dbb.dk)

DESIGN FOR ALL <http://www.designforall.org/>

DUBLINCORE <http://dublincore.org>

DUXBURY <http://www.duxburysystems.com>

EBRASS <http://www.ebrass.it>

EBU <http://www.euroblind.org>

EUROPEANA [www.europeana.eu](http://www.europeana.eu)

FINALE <http://www.makemusic.com>

GALIANO [www.galiano.it](http://www.galiano.it)

G.U.R.I. [www.gazzettaufficiale.it](http://www.gazzettaufficiale.it)

GUTENBERG [www.gutenberg.org](http://www.gutenberg.org)

HAL <http://www.dolphinuk.co.uk/productdetail.asp?id=5>

IEEE1599- <http://www.mx.dico.unimi.it/news.php>

IMDE451 2006 <http://www.i-maestro.org>

IMSLP [http://imslp.org/wiki/Public\\_domain](http://imslp.org/wiki/Public_domain)

JAWS <http://www.freedomscientific.com>

MIDI <http://en.wikipedia.org/wiki/Midi>

MusicXML , <http://www.musicmarkup.info/>

MusiXTeX [http://www.mab.jp/musicx/index\\_en.html](http://www.mab.jp/musicx/index_en.html)

NLS <http://www.loc.gov/nls/>

NOTEWORTHYSOFTWARE <http://www.noteworthysoftware.com/>

NVDA <http://www.nvda-project.org/>

OAI <http://www.openarchives.org>

RNIB <http://www.rnib.org.uk>

ROBOBRAILLE 2013 <http://www.robobraille.org>

SIBELIUS 2013 <http://www.sibelius.com/>

TACTILEVIEW <http://www.tactileview.com>

TIRESIAS <http://tiresias.org>

TOCCOFINALE <http://www.toccofinale.org/>

VISIV [www.visiv.co.uk](http://www.visiv.co.uk)

WEASEL <http://www.cultivate-int.org/issue8/weasel/>

WEDELMUSIC <http://www.wedelmusic.org>

W3C <http://www.w3.org/TR/SVG>