ACCESS TO MUSICAL INFORMATION FOR BLIND PEOPLE

Nadine Baptiste-Jessel
IRIT-UT2
baptiste@irit.fr

ABSTRACT

In this paper we describe our approach to helping blind people access musical information. Guidelines of our approach are centered on information accessibility according to user disability. We present the process which allows musical information to be coded and converted so that it may be read, played and analysed by a blind musician. We focus our approach on the various levels of description of the score done by several codes and we exploit and describe existing results like BMML (Braille Music Markup Language) defined during Contrapunctus European project. We describe and comment on different scenarios using existing free conversion modules and software to obtain a score in BMML that may be read and manipulated by blind people using BMR (Braille Music Reader). We recommend the tutorials created during the Music4VIP European project.

1. INTRODUCTION

Some IT solutions exist to help blind people to access music, but analysis of these reveals both their utility and their limits. As Antonio Quatraro (blind musician) says, there are many factors which hinder the musical education of blind people - the lack of special needs training of teacher in mainstream schools and conservatoires, the difficulty of finding music scores in an accessible format and the persistent idea that music can be only learnt by ear.

Compared with existing methods of converting music into Braille like [1] and [2] our solution is based on the design of BMML (Braille Music Markup Language) [3]. To explain the process we first describe the principles of Braille music, in the next part the tools and code used to translate a score into an accessible format and in the final part we recommend the use of BME2 (Braille Music Editor) and BMR (Braille Music Reader) [4].

2. BRAILLE MUSIC PRINCIPLE

The rules used to create a Braille music score are presented in the New International Manual of Braille Musical Notation compiled by Betty Krolick [5]. It is important to note that, just as with conventional musical notation, this is an international code and so it is possible to exchange Braille scores between different countries. To explain the challenges involved in learning Braille music we divide the rules into three types: the simple rules, the presentation rules and the contraction rules. In this chapter we also describe BMML (Braille music markup language).

2.1 The simple rules

These are the rules used to transform music information into one or more Braille characters.

For example: the G clef is indicated by three Braille characters: ⠼⠛⠁ - although this information is not so important in Braille because the octave signs, rather than clefs on a staff, indicate the register of specific pitches in Braille music.

The octave sign is placed immediately before the note, for example the 4th octave mark is ⠸

The name of a note is indicated by the four upper dots of a Braille character :

⠉	⠙	⠑	⠋	⠛	⠁	⠃
C	D	E	F	G	A	B

Table 1. *The Braille Name of note*.

The duration is indicated by the two lower dots, as shown below.

Whole notes and 16ths ⠤

Half notes and 32nds ⠴

Quarter notes and 64ths ⠦

Eighth notes and 128ths ⠲

So a short simple score will be transcribed:

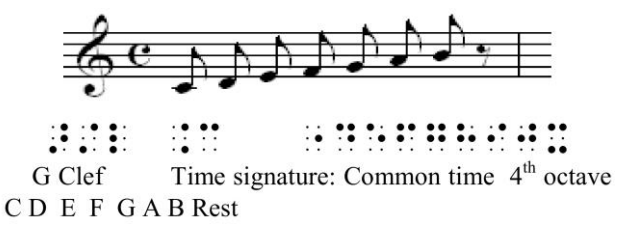

Figure 2. A simple score in Braille.

2.2 Presentation rules

Two presentations exist for keyboard instruments or other ensembles: bar over bar and section by section.

Bar over bar presentation presents a Braille line for each stave and the first note of each bar appears in parallel.

Section by section presentation presents a number of bars for one stave followed by a number of bars from the other.

These different presentation rules are available for all the score.

Other presentation rules exist to add in the Braille score the corresponding print page number to facilitate collaboration with sighted musicians.

2.3 Contraction rules

There are two types of contraction rules, dot reduction and character reduction. These different rules reduce the reading time and the number of pages in a Braille score. The rules are designed to help reader with a good knowledge of Braille music.

Example of dot reduction:

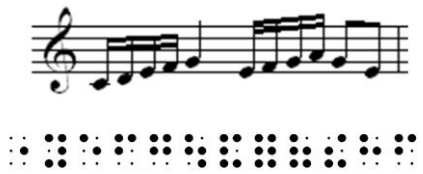

Figure 3. Example of Braille dot reduction.

The first note of the first double group is written with dots 3 and 6 but for the other note these duration dots are missing. The same reduction is not possible in the second part of the example because there would be an ambiguity with the last two notes.

Example of character reduction :

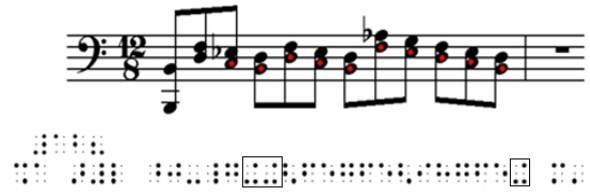

Figure 4. Example of Braille character reduction.

When the same interval appears several times the first interval sign is doubled and then one interval sign is placed at the end.

To store all the Braille information we created the BMML code during the Contrapunctus project.

2.4 BMML

BMML code was designed with following goals:

- to encode Braille structure and content as defined [3],
- to facilitate conversion from and to other music notation encoding such as MusicXML [4],
- flexibility to support different Braille music dialects.

The grammar of BMML is specified in [3] .Very briefly we can say that the BMML elements are of three types:

- a specific header in which is encoded all data relating to the document archiving and its structure,
- container elements which require a specific number of “children”. A child can be another container or a text element,
- text elements which represent the Braille text coded in Unicode.

BMML attributes are used to encode the meaning of each text element. A lot of them are required.

The following paragraph shows an very simple example of BMML but BMML can support more complex notation (tuplets, ornements, …) which permits its use by professional musicians.

3. A SCENARIO TO TRANSFORM A SCORE IN BMML

The objective of this scenario is to prove that it is possible to transform automatically a score in pdf format to a score in BMML. This example uses only free tools.

3.1 First step

The first step consists of finding a score in pdf format. It is possible to find this kind of score in an online library.

The score is Bach, Johann Sebastian, Minuet BWV Anh. 114 which is a public domain score found in the Petrucci Library site

http://imslp.org/wiki/Notebooks_for_Anna_Magdalena_Bach_%28Bach,_Johann_Sebastian%29

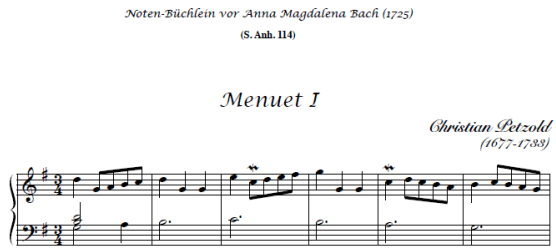

Figure 5. The *Minuet* in pdf.

3.2 Second step

We use the trial version of the Myriad-online.com product call PDFtoMusic Pro to convert the pdf score into MusicXML format.

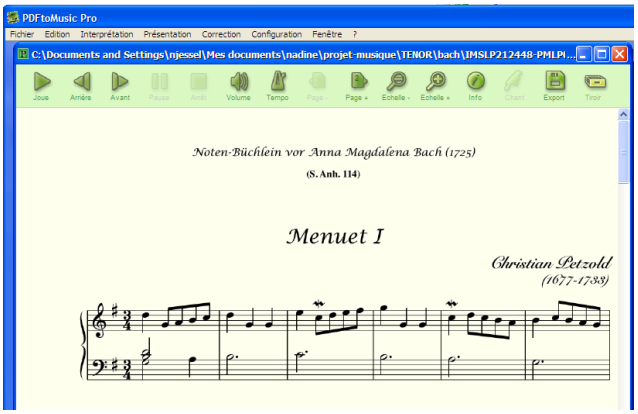

Figure 6. The *Minuet* after music recognition.

The MusicXML document generated contains layout information and note information as follows:

```
▼<score-partwise version="2.0">
  ▼<work>
     <work-title>Noten-Büchlein vor Anna Magdalena Bach (1725)</work-title>
   </work>
  ▼<identification>
     <creator type="composer">ChristianPetzold (1677-1733)</creator>
    ▼<encoding>
      ▼<software>
         PDFtoMusic Pro v1.5.0 Build 14482 (c) Myriad - http://www.myriad-online.c
       </software>
       <?PDFtoMusic Document type 0100- 00000000?>
       <supports attribute="new-system" element="print" type="yes" value="yes"/>
       <supports attribute="new-page" element="print" type="yes" value="yes"/>
     </encoding>
   </identification>
  ▼<defaults>
    ▼<scaling>
       <millimeters>6.773331</millimeters>
       <tenths>40</tenths>
     </scaling>
    ▼<page-layout>
       <page-height>1650.001</page-height>
       <page-width>1275.000</page-width>
      ▼<page-margins type="both">
         <left-margin>59.055</left-margin>
         <right-margin>59.055</right-margin>
         <top-margin>59.055</top-margin>
         <bottom-margin>59.055</bottom-margin>
       </page-margins>
     </page-layout>
    ▼<appearance>
       <line-width type="stem">1.2492</line-width>
       <line-width type="beam">5.8333</line-width>
       <line-width type="staff">0.6250</line-width>
       <line-width type="light barline">1.2239</line-width>
```

Figure 7. The layout information in MusicXML code.

In this first part of score we can see a lot of layout information which will not be found in the Braille score.

The note information with pitch, duration and octave signs is similar to the information in Braille.

```
▼<note>
  ▼<pitch>
     <step>D</step>
     <octave>5</octave>
   </pitch>
   <duration>6720</duration>
   <voice>1</voice>
   <type>quarter</type>
   <stem default-y="-45.31">down</stem>
   <staff>1</staff>
 </note>
▼<note>
  ▼<pitch>
     <step>G</step>
     <octave>4</octave>
   </pitch>
   <duration>3360</duration>
   <voice>1</voice>
   <type>eighth</type>
   <stem default-y="3.09">up</stem>
   <staff>1</staff>
   <beam number="1">begin</beam>
 </note>
▼<note>
  ▼<pitch>
     <step>A</step>
     <octave>4</octave>
   </pitch>
   <duration>3360</duration>
   <voice>1</voice>
   <type>eighth</type>
   <stem default-y="6.40">up</stem>
   <staff>1</staff>
   <beam number="1">continue</beam>
 </note>
```

Figure 8. The note code in MusicXML.

3.3 Third step

We use the online tool provided on the Music4VIP website which converts the MusicXML score into BMML. It is a very simple on line tool which is accessible for blind people.

Figure 9 . MusicXML to BMML conversion tool.

The BMML file obtained is shown below.

```
▼<score version="0.81">
 ▼<score_header>
  ▼<part_list>
   ▼<part_data id="bmml-p01" chord_dir="down">
     <name id="bmml-0001" value="part 1">⠏⠁⠗⠞ ⠼⠁</name>
    </part_data>
   ▼<part_data id="bmml-p02" chord_dir="down">
     <name id="bmml-0002" value="part 2">⠏⠁⠗⠞ ⠼⠃</name>
    </part_data>
   </part_list>
  </score_header>
 ▼<score_data>
  ▼<generic_text id="bmml-0003" type="title" value="Noten-Büchlein vor Anna Magdalena Bach (1725)">
     [illegible]
   </generic_text>
 ▼<part id="bmml-p01">
   <part_name id="bmml-0017">⠏⠁⠗⠞ ⠼⠁</part_name>
   <space id="bmml-0018"> </space>
   <key_signature id="bmml-0404" value="1">⠩</key_signature>
   <time_signature id="bmml-0405" values="3,1024">⠼⠉⠲</time_signature>
   <clef id="bmml-0021" name="G" line="2">⠜⠌⠇</clef>
   <space id="bmml-0022"> </space>
  ▼<note id="bmml-0023">
   ▼<note_data>
      <pitch>36</pitch>
      <duration>1024</duration>
    </note_data>
    <octave id="bmml-0024" value="5">⠨</octave>
    <note_type id="bmml-0025" name="D" value="quarter_or_64th">⠱</note_type>
   </note>
  ▼<note id="bmml-0026">
    <?inknotation cbeams="0,1"?>
   ▼<note_data>
      <pitch>32</pitch>
      <duration>512</duration>
    </note_data>
    <octave id="bmml-0027" value="4">⠈</octave>
    <note_type id="bmml-0028" name="G" value="8th_or_128th">⠛</note_type>
   </note>
  ▼<note id="bmml-0029">
    <?inknotation cbeams="1,0"?>
   ▼<note_data>
      <pitch>33</pitch>
      <duration>512</duration>
    </note_data>
    <note_type id="bmml-0030" name="A" value="8th_or_128th">⠋</note_type>
   </note>
```

Figure 10. Example of BMML code.

The code indicates 2 parts in the head tag, a part for each hand for the keyboard. We can note container elements such as note_data and text elements such as note_type. We also see, for example, the arguments such as value="4" for the octave and name="D" for the name of the note.

Note the "inknotation" indication which refers to graphical aspects of the original musical notation.

3.4 Verification step and recommendation

To check the transcription, we can use either automatic tools or manual tools.

It is possible, for example, to create an automatic tool with the help of xquery to count the number of parts, bars or notes in order to establish easily whether any information has been lost.

Another automatic tool can compare the <step> tag in MusicXML with the attribute name in <note_type> in BMML to verify that they are the same.

To compare code we can also do the reverse transcription from BMML to MusicXML and compare the resulting graphic score with the original one. Some layout may be different – this is normal because the Braille code is not designed to store the graphical aspects of musical notation.

The following figures show the reverse transcription from BMML to MusicXML done with the online tool available on the Music4VIP site. Both in Melody Assistant and MuseScore there is a problem of text overlapping and we can also see that the stem direction of notes differs – all of which proves that the layout information is missing in the code.

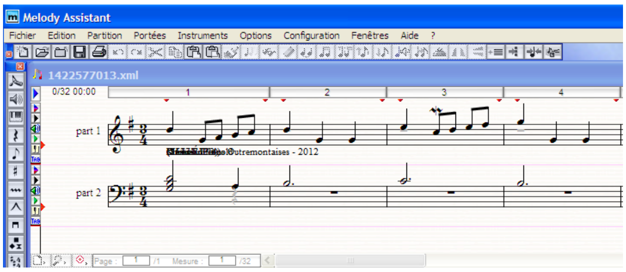

Figure 11. The MusicXML score in Melody assistant.

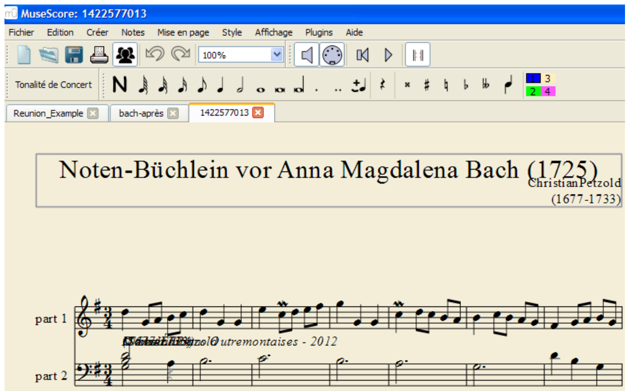

Figure 12. The MusicXML score in MuseScore.

If we download a MIDI File from http://www.free-scores.com/partitions_telecharger.php?partition=239
the graphic representation is not the same with either MuseScore or Melody Assistant.

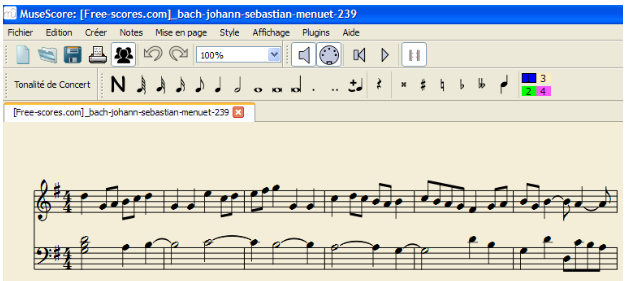

Figure 13. The MIDI score in MuseScore.

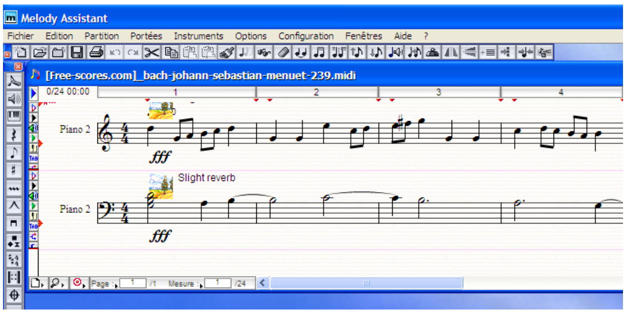

Figure 14.The MIDI score in Melody Assistant

The key signature is not the same in the two notation applications because the key signature is not explicit in MIDI file so the software has to interpret the information.

The time signature is the same in both applications but is not the same as the pdf file. This is an important problem because it implies a different meaning of the music. If we convert this file into BMML the musical information is very different from that obtained with the conversion of a pdf file. MIDI files have to be used with great care because they do not contain important information like fingering, slurs or ties.

In general, it will be of benefit to download digital scores from a reliable site like a library site. Having obtained a BMML file from whichever source a blind person can manage the score with a Braille reader or editor. We describe this process in the following section.

4. THE READER OR EDITOR USED BY BLIND PEOPLE

BMR is free software which permits blind users to read, learn and listen to music in a multimodal environment. Each piece of musical information can be accessed in Braille on a refreshable Braille display or by sound via MIDI or in a spoken form.

For a beginner, different kinds of Braille music elements may temporarily be hidden or a brief description of an unknown sign can be given.

With BMR the user can browse the score, add annotations, find parts and bars and skip through the score along hierarchical elements. He can, like a sighted person, have access to all the information contained in the score.

In the status bar of BMR we can read the musical information which corresponds to the Braille character which is after the cursor.

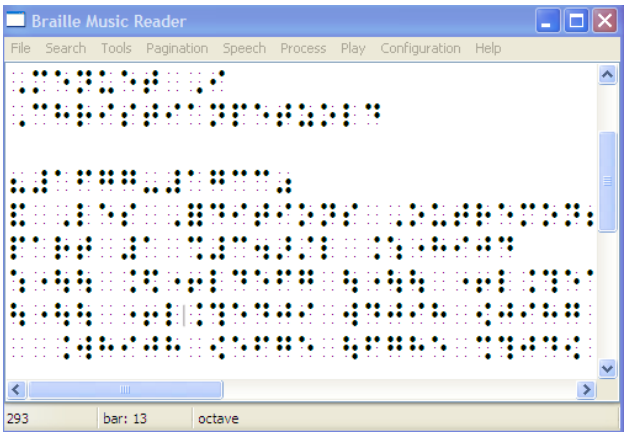

Figure 15.The Braille score in BMR

With BME2 [7] the same functionalities are available but, in addition, the user can write musical information in Braille. So users can create their own scores and produce BMML files. With the conversion module they can create MusicXML files and share them with sighted musicians. Of course, the result in graphic form will not be so well laid out as it would be if it had been originally produced in a conventional music editing application but the score will be immediately readable by a sighted musician and the minor formatting issues can be tidied up in a few minutes. This is enormously valuable for collaboration between sighted and blind musicians, whether they be teachers, students or members of a musical ensemble.

The way a blind person may access and make music without external aid is explained and demonstrated in the video found at : `http://www.music4vip.org/video_lesson_item/7`.

5. CONCLUSION

This paper describes how a blind user can access, convert, read and write musical scores. The conversion modules plus reading and editing tools are free, accessible and based on the BMML code. To obtain an available score in Braille it is necessary to convert a score into MusicXML format produced by an official editor or library. To facilitate the collaboration between sighted and blind musicians a reader with musical notation and Braille windows will be designed.

Acknowledgments

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6. REFERENCES

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[2] `http://www.dancingdots.com/main/goodfeel.htm` (consulted 01/15/2015)

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[4] `http://www.music4vip.org/braille_music_reader` (consulted 01/15/2015)

[5] Bettye Krolick, *New International Manual of Braille Musical Notation*, World Blind Union, 1996

[6] Michael Good, January 13, 2015, MusicXML Definition version 2.0, `http://www.musicxml.com/for-developers/musicxml-xslt/musicxml-2-0-to-1-1/`

[7] `http://www.veia.it/en/bme2_product2015`