BMML: Braille Music Markup Language

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Abstract - *Thanks to the WAI (Web Accessibility Initiative) guidelines for producing accessible HTML documents, visually impaired people can have better access to a lot of textual information. Concerning musical score, several encoding formats are available, focusing on the representation of different aspects of this kind of content. As XML is the standard for exchanging content through the Web, several XML applications have already been specified for representing musical scores, using the traditional music notation. As a result, users can access and share a lot of different types of musical content using the Web. However, for specific notations – like the Braille one - no dedicated XML application has been developed yet. Therefore, visually impaired musicians cannot easily represent, share, and access scores using the Web. This paper presents the application we have developed to respond to this need: BMML (Braille Music Markup Language). BMML handles specificities of Braille Music notation and takes into account the core features of existing formats. The main objective of BMML is to improve the accessibility of Braille musical scores.*

Keywords: Musical score, Braille, Braille musical score, Markup language, Accessibility, Application for visually impaired users.

1 Introduction

There are approximately 161 million visually impaired people in the world, according to the European Blind Union [1]. For this population, it is hard to edit, access, and read musical score. For activities like word processing, e-mailing, reading electronic publications, getting information, many blind people already use computers as often as sighted persons. However, using computers in the musical domain is not yet common among the blind musician community.

Firstly, blind musicians need to produce musical scores. Such cases occur, for example, in a learning situation when a blind music teacher wants to produce graphical scores for sighted students or, when blind students want to modify specific scores or produce an exam in a graphical form for their sighted teacher.

Secondly, blind people need easy access to Braille musical scores. Even if several Braille libraries exist (e.g. AVH in France, Biblioteca Italiana per Ciechi, monza – Italy, The National Library Service for the Blind and Physically Handicapped - Library of Congress - Washington, USA), Braille musical scores are neither well referenced nor structured. As a consequence, Braille scores or parts of scores are difficult to retrieve, even on the Web.

Thirdly, the transcription of printed musical scores is time consuming and interests transcribers less and less. Even though some tools exist to automatically transcribe musical scores into Braille ones (Toccata [2], BME [3], GOODFEEL [4]), each of them uses a proprietary format. As a result, these Braille scores are not easily transformable and exchangeable. As a result, there is an urgent need to define a unique format that could be used for representing Braille musical scores, improving score exchange possibilities between blind musicians.

The European project Contrapunctus [5] was created to address these issues and one of its goals is to develop a unique format for encoding Braille scores, taking into account all specificities of the Braille music notation. As a result, an XML-application called BMML (Braille Music Markup language) has been designed to fulfill previously mentioned requirements.

In this paper, we firstly discuss related works in section 2 and more precisely recommendations for representing musical information and relevant existing formats for encoding music. We highlight in section 3 the peculiarities of Braille music notation in opposition to the traditional style. In section 4, the guidelines we develop to handle these peculiarities are presented (BMML schema). Finally, we illustrate our model through the example of a Braille score XML document using the BMML schema we proposed. Section 5 concludes this paper and presents future works.

2 Related works

2.1 Score and Music Standard

A musical score is a document that contains all musical information about a given piece of music. Musicians can write or read a musical score in order to play and perform the written music. Using scores, musicians communicate, share, learn and compose music. Various standards have been defined to help the development of language that handles musical content, their representation, and their relationship. Among musical standards, SMDL (Standard Music Description Language) [6] and SMR (Symbolic Music Representation) [7] are the most important. We give details about these standards in the following sections.

2.2 Music standard

2.2.1 SMDL

The current existing musical formats follow some of the main orientations (i.e. domains) which are defined in the Standard Music Description Language, namely:

- *Logical* domain which contains the music;
- *Gestural* domain which is the current performance;
- *Visual* domain: the graphic visual display of the musical work, and
- *Analytical* domain which consists of the theoretical analyses and commentaries.

2.2.2 SMR

Symbolic Music Representation (SMR) is a set of recommendations to represent musical information. These recommendations suggest the representation of several aspects (named domains) for the encoding of musical information: a content-oriented domain and a presentation-oriented one. Concerning the presentation aspect of musical information, even if one recommendation considers the accessibility for blind people; it does not define how to implement this accessibility.

2.3 Music Encoding Format

There is a lot of music encoding formats, the most usual and typical are presented hereafter.

MusicXML[8] is designed to be a universal translator and an interchange format for common Western musical notation from the 17th century onwards. As it is usable by a lot of notation programs, sequencers and music performance or education programs, it has become a de facto standard.

NIFF Notation Interchange File Format [9] [10] is a file format designed to encode in a very precise way the graph used to present the musical score, so it permits the interchange of music notation data between music notation editing, publishing programs and music scanning programs.

MIDI (Musical Instrument Digital Interface) [11] is a music industry standard communications protocol that lets MIDI instruments and sequencers (or computers running sequencer software and equipped with a MIDI interface) talk to each other to play, edit and record music. MIDI is a code that is designed to produce sound.

PLAY Code [12] aims at offering the opportunity of exchanging information with sighted musicians thanks to the Braille Music Editor (BME).

The PLAY Code is a proprietary code and cannot be easily reused and extended. Musicxml, Niff and Midi don't take into account Braille music notation. These reasons justify the specification of a new format for encoding Braille musical scores.

3 Braille Music Notation

3.1 Visual Impaired Special Needs

In an educational or professional context, blind musicians need to easily communicate with sighted ones. Because both of them use different notations (i.e. Braille and printed notations) for the same content (a musical score), correspondence indications between these two notations should be added. For instance, the printed version of a Braille score has to be explicitly indicated in a Braille score. Indications to easily find a corresponding audio version have to be added too. As a result, specific metadata for visually impaired people have to be represented in addition to the classic ones (e.g. title, composer, etc.) that are already described in some of existing formats (e.g. MusicXML for instance).

3.2 Peculiarities of Braille Music Notation

Braille music notation [13] is very different from ordinary music notation. A Braille score consists in a linear sequence of symbols representing notes, chords, parts, and rhythmic patterns. Due to the limited number of Braille signs available (64 in total) musical elements are produced using a combination of one or more Braille signs. So the meaning of each Braille sign is determined by its context.

Additionally, Braille is read in a linear way. When considering a musical score, this type of reading is not fully relevant. Braille writing has developed a lot of strategies and some special symbols to reduce the text length and to make it easier to read.

Hereafter is an outline of some specific Braille concepts that do not exist in printed notations and that must be taken into account when defining the code of Braille musical score.

3.2.1 Repeats

A major specificity of Braille music is the extensive use of repetition signs, compared to printed music. This can simplify reading, assist memorization and save space.

For example, in Braille, a special character (dots 2356) represents a full- or part-measure repeat.

3.2.2 Sequences

In order to reduce reading time by having fewer characters, a sequence of similar elements is usually written in Braille by doubling the element at the beginning of the sequence and repeating it at the end. For instance, a sequence of two-notes chords, that all have the same 3rd interval, can be written by doubling the interval sign after the first note and putting it after the last note. As a result, for each chord (except the first and last chord) of the sequence, its second note (the 3rd interval) is not written. The same applies for a sequence of rhythmic groups.

In the case of a succession of several identical rhythmic groups, it is possible to double the grouping sign before the first group.

3.2.3 Octave Specification

When we use in a Part a modification of octave, the first note concerned has to be preceded by two octave marks. The first mark indicates the value of the octave according to the position of the note on the printed score; the second indicates the real value of the octave.

3.2.4 Chord, Note and Rest Durations

For a note, the dots 1, 2, 4, and 5 of the Braille character represent its pitch. The absence or presence of dots 3 and/or 6 determines its duration. Each note or rest has two duration value possibilities determined using its context. Some Braille characters can prefix a note to precisely indicate its duration.

In addition, for chords in which the notes have the same duration, only one note is written. The others are indicated by their intervals from that note.

3.2.5 Use of In-accords

In Braille, musicians can only read horizontally. Therefore, vertical information must be provided as an horizontal sequence of characters. When all of the harmonic parts do not change at the same time, they are shown by dividing the measure into voices and are made by making use of in-accords, which are unknown in printed scores. This symbol indicates that the following notes belong to another voice belonging to the same measure.

3.2.6 Key Signature

Key signatures reflect the number of flats or sharps, not the actual pitches as in printed scores.

3.2.7 Slurs and Ties

In printed scores, all slurs and ties are represented by a similar line over or under the relevant notes. In Braille, various characters are used according to the context. Among these contexts, we can quote:

- Slur between two notes or chords,
- Phrasing slur over more than four notes or chords,
- Beginning and end of phrasing slur on one note
- Beginning and end of short slur on one note
- Slur from one in-accord part to another
- Straight line between staves for voice leading
- End of straight line
- Slur added by an editor in printed scores
- Slur that does not end on a note
- Slur for short appoggiatura;

3.2.8 Layout

The main difference with music in print is the concept of spatial dimensions. For music in print both the dimensions are used to convey information. In Braille both presentations are available:

- section by section layout where a group of measures of a part or of an instrument alternate with the same group of measures of another part or instrument. The number of measures in a group is defined by the transcriber and stored in the metadata of BMML.
- bar by bar layout where a measure of a part or of an instrument alternate with a measure of another part or instrument.

The information of this layout is defined in the metadata of BMML and a transformation process could propose the right presentation.

4 A Markup Language for Braille Music

There is currently no unified format for encoding the Braille representation of musical score. Indeed, existing formats mostly concern the representation of printed notation and dedicated ones are proprietary, not extensible and not readable. With the help of XML technologies, the drawbacks of existing codes are missed. As a result, the BMML code is a solution to store and exchange Braille musical score.

4.1 BMML Description Logic

According to the specificities of Braille music, we treat a Braille musical score as a sequence of notes followed and preceded by describers corresponding to octave, tie, slurs, fingering, nuances, etc... as illustrated in the figure 1.

In the same way, a Braille score is considered as a sequence of measures which are interconnected by the means of measure connectors like repetition, In-accord, Dynamics, etc. symbols (see Figure 1).

Equally important, BMML takes into account the abbreviation used in Braille music in order not only to reduce the score size but also to facilitate its reading and memorizing. As an illustration, here are some examples of Braille abbreviation shapes.

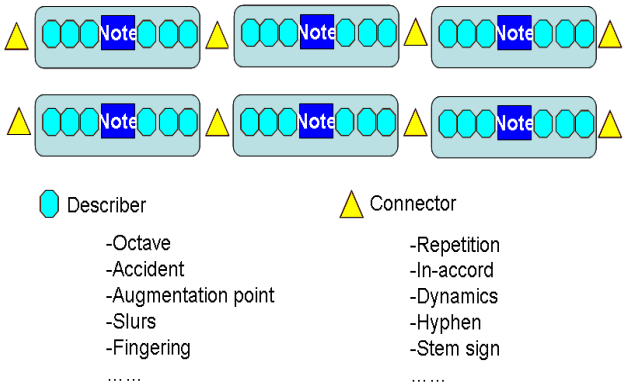

Fig. 1: Structure of a Braille score.

Shape 1:

The first type of shape expresses a sequence of actions which will be repeated a number of times (figure 2).

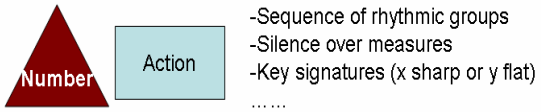

Fig. 2: A Braille abbreviation structure

Example (figure 3):

If there are four or more accidentals in a key signature, the number sign is used instead of writing the flat sign many times.

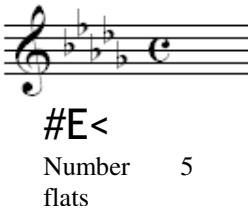

Fig. 3: Key signature information, using Braille abbreviation structure

Shape 2:

Another type of shape, as illustrated in figure 4, permits the maintaining of a property on a sequence of elements by doubling the symbol of the property before the sequence and putting it only once after the sequence.

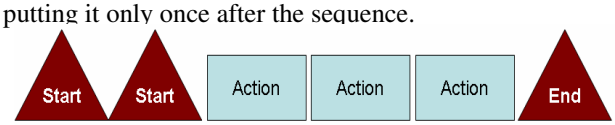

Fig. 4: Structure of a sequence abbreviation

Example:

The example below (i.e. figure 5) shows how each note in the sequence is followed by the corresponding 3rd interval. Thus, the first note of the sequence is preceded by the couple of third interval symbols. Subsequently, the last note is followed by the third interval symbol.

It is worth reconsidering the example illustrated in figure 5 to show an important aspect of the coding process. This example can be Braille-coded in two ways. The first solution consists in using the abbreviation structure: only the information that is on the Braille musical score will be encoded. On the contrary, the second solution will encode all the notes. We have chosen the first option that encodes the abbreviated form, leaving to the reading program the generation of the printed content.

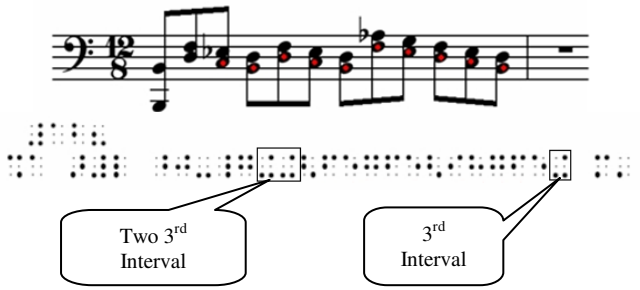

Fig. 5: Sequence of Third interval using sequence abbreviation structure

4.2 BMML Schema Definition

We developed the initial definition of the code using the W3C XML Schema specification [14].

According to our model, a Braille score is composed of metadata and one or several Parts. In addition to metadata that is already used in the previously mentioned formats (cf. section 2.3), elements like: Print link, Audio link, ISBDPM (International Standard Bibliographic Description for Printed Music) [15] have been added to improve, on the one hand, communication between visually impaired and sighted musicians and, on the other hand, the understanding of the score. Finally, specific information regarding Braille score such as both the line number on a page and the symbol number in a line have been added too. Such metadata is illustrated in figure 6.

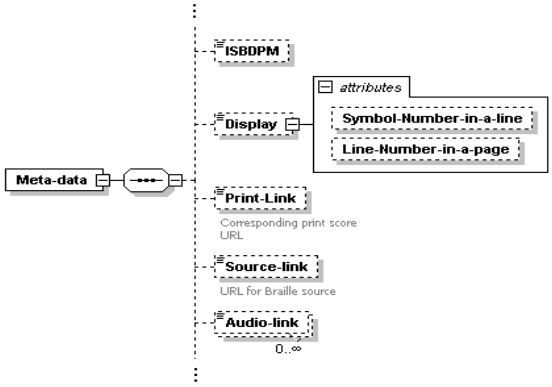

Fig. 6: Excerpt of the metadata

We stress that in Braille music, a Part consists of one or several Sections which are composed of one or several Measures. Each section is characterized by its Key, Key signature and Time signature. Each measure can be connected to others using Connectors.

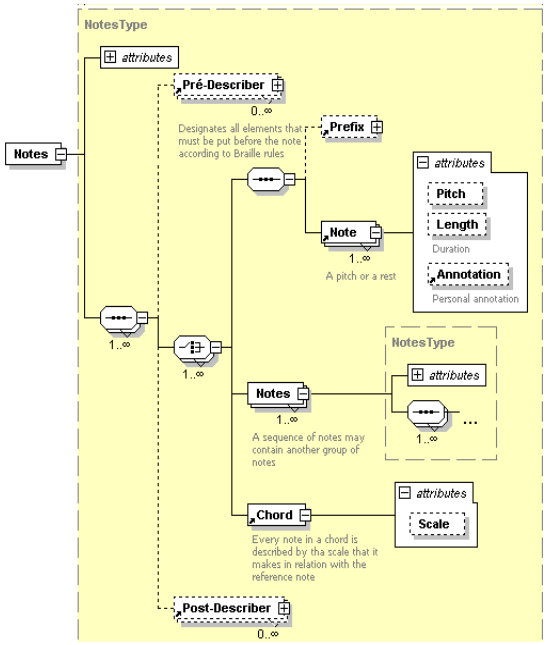

Fig. 7: Notes element Structure

Notes element is a set of Notes which is, according to the writing rules of Braille music, preceded by Pre-describer and followed by Post-describer (cf. figure 7). Moreover, in Braille score, Note and Rest are represented in the same way.

When the context of some Braille signs (e.g. note/rest durations) is not sufficiently clear to precisely determine their meanings, prefix elements are used (cf. figure 8).

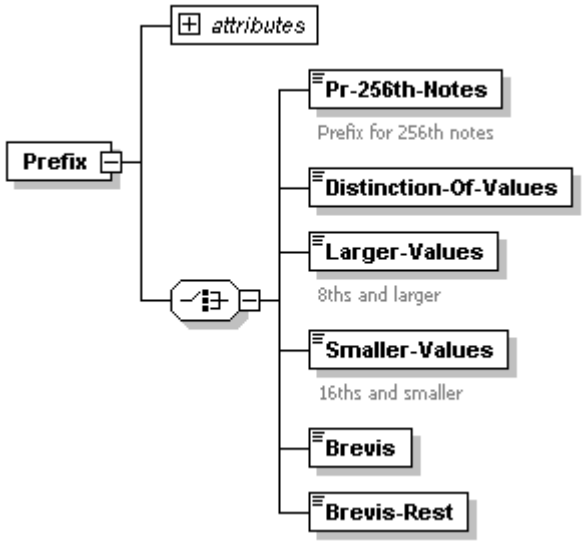

Fig. 8: Prefix element structure.

4.3 A sample of a BBML Braille score

An example of a score containing 6 flats in the key (which means that the musical score is in the tonality of G flat major) and a sequence of thirds is given in Figure 9. This score is then transcribed into Braille using its BMML representation. In this example, we highlight the use of Braille abbreviation in both cases (Key signature and chords sequence) according to the Braille notation rules mentioned in section 3.2. Both in figure 9 and in the XML document, the chord sequence and its corresponding Braille abbreviation are highlighted in green while the key signature and its corresponding abbreviation are highlighted in cyan.

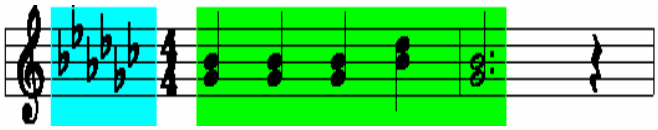

Fig. 9: A print score example

Here is the corresponding valid BMML score representation.

```
<?xml version="1.0" encoding="UTF-8"?>
<Score xmlns="http://www.punctus.org/bsml"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.punctus.org/bsml/bsml.xsd"
>

<Part Instrument="Piano" Number="1">
<Section Number="1"  Movement="Moderato">
…
<Key-Signatures>
        <Key-Signature Number="6" Accidental-Sign="Flat"
Concise-Presentation="true"/>
</Key-Signatures>
…
<Measure Number="1">
  <Notes>
      <Chord Scale="Third"/>
      <Chord Scale="Third"/>
      <Pré-Describer>
      <Octave  Number="4" Display="true"/>
      </Pré-Describer>
      <Note Pitch="G" Length="Quarters-64ths"/>
      <Note Pitch="G" Length="Quarters-64ths"/>
      <Note Pitch="G" Length="Quarters-64ths"/>
      <Note Pitch="B" Length="Quarters-64ths"/>
      </Notes>
</Measure>

<Measure Number="2">
  <Notes>
      <Note Pitch="G" Length="Halves-32nds" />
      <Post-Describer>
    <Symbol-Point3/>
      </Post-Describer>
      <Chord Scale="Third"/>
      <Note Pitch="Silence" Length="Quarters-64ths"/>
      </Notes>
  </Measure>
       </Section>
    </Part>
</Score>
```

5 Conclusion

Since BMML complies with the International Braille Music Manual [13] and is based on the XML format which is the standard format for structuring and exchanging data, we think that the impact of this work is significant and will enhance access to Braille music for professionals and visually impaired people.

Indeed, by using BMML language, we could perform the following tasks:

- Information searches, because it contains metadata allowing the identification of the corresponding printed score, the tools and software used.
- Teaching and learning of Braille scores and/or music.
- Score navigation and queries about content.
- Music analysis.

Thus, the Braille format we have defined will allow the representation of musical Braille scores in different libraries to be unified; it will thus facilitate the exchange of scores from various origins.

In order to convert existing Braille scores into this new BMML format, a recognition and conversion tool has been developed. This will permit the conservation of musical heritage as many more scores will become readable.

On the whole, BMML is the first stage in the improvement of the access to Braille music. We intend now to develop tools for publishing and querying BMML scores.

We also will develop a BMML Easy-reader which permits a blind musician to read a Braille score with the help of a Braille display and/or a vocal synthesis.

6 References

[1] European Blind Union Guide
http://www.euroblind.org/fichiersGB/visincfr.html

[2] Toccata,
http://members.optusnet.com.au/~terryk/toccata.htm

[3] BME (Braille Music Editor)
JESSEL Nadine, TORNIL Bertrand, ENCELLE Benoît
http://www.snv.jussieu.fr/inova/villette2002/act12.htm

[4] GOODFEEL
Bill McCann,
http://www.dancingdots.com/gfrench.htm

[5] Contrapunctus,
http://www.punctus.org/

[6] SMDL (Standard Music Description Language):
Charles F. Goldfarb
http://xml.coverpages.org/smdl10743-1995.pdf

[7] Symbolic Music Representation in MPEG
Bellini, P.; Nesi, P.; Zoia, G.
IEEE Multimedia
Volume 12, Issue 4, Oct.-Dec. 2005 Page(s): 42 – 49

[8] MusicXML Definition
Michael Good (Recordare)
http://www.musicxml.org/xml.html

[9] NIFF
http://www.music-notation.info/en/niffml/niffml.html

[10] NIFF Transcription and Generation of Braille Musical Scores. Didier Langolff, Nadine Jessel, Danny Levy
The virtual Score, Representation, Retrieval, Restoration idem
http://www.ccarh.org/publications/books/cm/vol/12/07

[11] MIDI Specification
http://www.midi.org/about-midi/specshome.shtml

[12] Play Code
http://www.dodiesis.com

[13] Braille format: New International Manual of Braille Music Notation
http://www.opustec.com/products/newintl/

[14] W3C Schema definition
http://www.w3.org/XML/Schema

[15] ISBD(PM)
International Standard Bibliographic Description for Printed Music.
http://www.ifla.org/VII/s13/pubs/ISBDPM_Nov10_2004.pdf