



Web Delivering of Music Scores

WEDELMUSIC Editor

User's Manual/Help

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Abstract:

The whole specification is comprised of 4 parts. In this part is presented (i) the model and language for distributing music via Internet, a unique language to have the possibility of managing in a uniform manner music in image, symbolic and audio format and considering also problems of protection, (ii) a set of applications for music editing, listeners synchronised with visualisation, music printing.

Keyword List:

music, internet delivering, audio format, image format, symbolic format, watermarking, protection, encryption, music distribution, copyrights, mp3, visually impaired people, speech music, Braille music, music analysis, music printing, music format.

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1 Introduction & project Objectives

W EDELMUSIC is an innovative idea for allowing the distribution of interactive music via Internet. This is possible thanks to the definition and implementation of

- (i) a unified model for distributing music in its several forms (audio, symbolic and image),
- (ii) reliable mechanisms for protecting music based on watermark,

To receive music in symbolic form at it also allows exploiting commercially new functionalities for music consumers and, thus, it allows the opening of a new market for several specific applications.

1.1 Objectives

- (1) to make possible the distribution of interactive music via Internet preserving the owner rights and integrating in a unified model audio, symbolic and image formats.
- (2) to define and validate reliable mechanisms for protecting digital music objects; this protect the original music version (image, symbolic, audio) and allow modifications and processing. The protection algorithm is based on complexity and bound to an individual secret.
- (3) adoption of a model for distributing music, taking into account the different needs of music consumers and the definition of detailed allowed operations on digital music.
- (4) to trial the model with tools for distributing and providing music to both visually impaired (spoken music, Braille music) and sighted people in a unified manner.
- (5) to place the basis for exploiting new functionalities, opening a market for several new products.
- (6) to disseminate and promote the benefits of the new model and solutions by installing some W EDELMUSIC servers with the support and the validation of publishers, music schools and libraries.
- (7) To define a detailed exploitation plan for the results that is achieved. This is produced in a deliverable.
- (8) to reduce the costs for delivering music scores as a substitute of the paper; thus, a reduction of the environmental costs for distributing music.

In order to reach the above objectives suitable activities have been planned. The basic research phases mainly fall within the first year of the project. Results produced is verified and experimented with trial software which is implemented in parallel for providing hints to the research activity. Integration phases have also been planned for merging the various aspects and research lines.

The project presents an activity for collecting user requirements (for all project duration), considering use cases description, setup and management of the users groups, definition and gathering of content for the further activity of validation. The system specification consider W EDELM model and language, music editor, music Analyser and interface, music Viewer and Listener, interfaces for blind people, image score watermarking, audio watermarking, printing score watermarking, encryption model, server database, Local Distributor.

The system development activity in the project is devoted to define the W EDELM model and Language for music distribution, watermark algorithms for images of music scores, watermark algorithms for audio files, watermark algorithms for symbolic music while printing, encryption/decryption solutions for protecting digital music in its formats.

Specific tools is realised for experimenting the above solutions in W EDELM format: definition and trial of W EDELMusic Editor, integrator and converters; music Analysers and processors; interfaces for blind people; viewers and listeners; server for distributing music in W EDELM format; Local Distributor for managing music in W EDELM format. The above aspects is fully integrated.

A phase of final validation against users such as publishers, librarians, music schools, etc. is performed.

The project is maintained under control by an activity of assessment and evaluation in terms of scientific and technological quality and innovation, community added value and contribution to the EU policies, contribution to community social objectives, economic development and scientific and technological prospects, management and resources (for all the project duration). The results is disseminated and the use plan is prepared considering market analysis and technology watch. More specifically some promotional event such as a conference is organised. The project is managed considering the result of the activity of assessment and evaluation and maintaining the management as light as possible.

2 WEDEL Modeland Language

In this section, the problems of integration among music in symbolic and image score formats with the audio produced by the symbolic format (for example in MIDI) or acquired as auxiliary audio files are discussed.

2.1 Integration image scores and symbolic music

The integration of images of music and music in symbolic format is a big problem. Symbolic music presents a collection of information related to single music symbols and considering their relationships and semantics.

In this sense, from symbolic music it is possible to

- Reformate music according to different page dimension, relationships among symbols, and other user needs
- Modify music adding/removing/changing music notation elements
- Transposing music in several manners
- Formatting/visualising music for a different page shape or computer screen
- Generate a MIDI output to produce computer music
- Analyse music content on the basis of music notation symbols relationships
- Search on the basis of music melody and structure
- Print music in the desired format and resolution
- Re-justify music score according to justification parameters and micro spacing given by the user
- Main score can be built on the basis of the information contained in the parts (brackets grouping staff systems and other annotations of the conductor have to be added)
- Parts can be obtained from the main score (some details have to be added in some cases)
- Selecting parts for execution
- Execution of music presenting the right score image in the right time instant directly on the computer screen
- Etc.

Images of music scores present a strongly limited number of functionalities, and some relevant drawback. The main problems are:

- The dimension of the files containing images with respect to the space needed for containing the same amount of music in symbolic is about 1/1000. This ratio depends on the resolution used. To visualise an image of music on the computer screen is enough to have 80 dpi, to print it at least 300 dpi are needed. The delivering of image score should be at print resolution only if it is needed. It is also possible to use high resolution images on the computer screen if a conversion process is used when needed (this means that a real time conversion is needed). The solution is to acquire image of music score at a higher resolution to be sure in this way to have a master at a resolution that can be used for all the purposes. The correct resolution can be 600 dpi or 1200 dpi.
- The symbolic version of a main score can be produced by merging parts. This is impossible for image scores. A different set of images has to be provided for distributing main score and parts. A set of image for the main score and a set of images for each part.

The above functionalities possible for symbolic music are all infeasible on images of music scores. On that format it is only possible to:

- Print music sheets at the image resolution (typically low with respect to that of printers)
- Visualising music in a rigid manner according to the original formatting that the music has on the music sheet. Line breaking has to be maintained otherwise the composition of the single measures produce line staff of different lengths. This is totally unacceptable for the musicians and publishers
- Execution of music by using images of music score is impossible without a time code or an auxiliary audio. In any way the paging mechanism can be similar to that of MOODS. The alignment of image score and audio can be quite coarse.

Image of music scores presents some benefits with respect to the symbolic music. Image of music scores:

- are available at a lower cost for the publisher. They have archives of master music scores in paper version in most cases.
- can be distributed on the internet in quite safe manner. An image can be difficultly manipulated at low cost, thus we can suppose that they remain the same for their life. It is quite hard to modify music by modifying image sheets.
- are the only way to distribute some music piece. For instance: (i) very antique music pieces, (ii) music pieces with strange modern or antique notations, (iii) manually written music pieces.

This analysis means that both formats: image of music sheets and symbolic music are needed. Presently the former is much more interesting for publishers since it means low cost to go on the Internet distribution.

The latter substitute the first in the future, and probably not for all aspects. Very old and handmade scores remain in paper or image formats for several years and may be forever.

For this reason, it is interesting to study a format such as WEDEL Distribution format, WDF, that is capable of integrating both aspects.

In WDF, the image of music scores is prepared for allowing the organisation of the single staff lines on the computer screen. In addition, the resolution of the image is arranged according to the screen dimensions by starting from a strong enough resolution. In this way the visualisation of image of music is more flexible, reducing the problems of image of music scores. This allows the implementation of an acceptable mechanism for executing image score music on the basis of an auxiliary audio, or on the MIDI audio produced by the symbolic part.

In WDF, the integration of symbolic music and image score music is only formal in the sense that the format allow the inclusion of both aspects in the same WEDEL music object but the interactions between these aspects is minimum. They are linked via:

- common audio files that can be synchronised with both formats;
- common measures numbers;
- common labels letters or symbols.

The definition of relationships between symbolic elements, such as measures, and the specific image that contains the corresponding measure image is interesting. For example for showing: (i) the correct/modified/arranged music notation code of eventual critical pieces in the original music score (passing from music image to symbolic); (ii) for see the original notation or passage related to a symbolic aspect (passing from the symbolic notation to the corresponding image part).

More detailed relationships (for instance at level of single figures of the music notation) are totally unuseful. Computer screen can typically visualise several music measures at the same time and thus the resolution at level of single measure is not mandatory. To pass from a measure of the symbolic score to the same on the image score is enough to present the image containing the selected measure. For the same reasons also the synchronisation of a music score image or a symbolic music at the level of the single figure (note or rest) is not useful since during the music score visualisation with listening the screen presents a set of measures. It is enough to provide an approximate indication of where the musicians are to play the single music notation symbols. This can be done by simply having the synchronisation at level of measures or segment of measures (in the case of score images) and interpolating inside the available structures.

In this view, it has to be possible to:

- Include in the same WDF a symbolic music with an image music score.
- Include in the same WDF an image music score with a symbolic music.
- select a measure on the symbolic representation and jump to image representation of the page including the selected measure.
- select a measure on the image score music and jump to symbolic representation.
- Visualise symbolic music and image score music on the same computer at the same time in different windows.
- Execute image music score by providing the right music page at the correct time instant according to the selected audio. This can be done on the basis of an auxiliary audio file or by using the music produced

via MIDI by the symbolic representation of the same music. From the user point of view, it has also possible to increase and decrease the velocity of execution of both image score and audio file. This have a specific relevance form usic school and libraries.

2.2 Integration of music notation sources and audio formats

In this section the integration of auxiliary audio files and music in (i) symbolic format, and (ii) images of music score. Please note that the production of MIDI files from symbolic music does not present problems of synchronisation and it is given for granted since it is an operation available on all music editors. MIDI files can be produced stored and played in a second phase or can be played while produced.

In the following the interesting functionalities are reported:

- 1) to synchronise music in symbolic format with an auxiliary audio file for presenting on the screen music pages and listening the audio produced by famous authors and conductors.
- 2) to synchronise music in symbolic format with several different auxiliary audio files. This allow the user to compare different performances of different musicians and orchestras.
- 3) to synchronise music in image score format with an auxiliary audio file for presenting on the screen music pages and listening the audio produced by famous authors and conductors.
- 4) To reproduce music in both image or symbolic format synchronised with the audio and allowing the presentation of the right music piece in the right time instant according to the synchronisation decided.
- 5) To allow the decrement and increment of execution velocity adjusting the velocity of audio and of the music presented on the screen.

Please note that the synchronisation of an auxiliary audio for the purpose of simple visualisation can be approximated, for example at level of measure. It is very hard to synchronise symbolic music with an available recording of the music piece. In certain conditions, the synchronisation can performed automatically (for example when the rhythmic base of the piece is well marked, see ICM C 1995, 96, 97, 98, 99).

In general, the precise synchronisation at level of single figures is quite hard even for an expert. For this reason, in the project problems of synchronisation is studied by starting from a first manual synchronisation of audio and music in both symbolic and image formats. This allow to verify the real needs of synchronisation. Automatic synchronisation is studied but it is out of the scope of the project.

It is quite obvious that the synchronisation of an auxiliary audio with symbolic score can be much more precise than that with the images of the music score. In fact, each image or image slice may contain typically more measures and not only one. To improve the synchronisation it can be supposed to associate with the single images of music scores also the dimension and the position of the included measures.

The above mentioned needs of synchronisation can be satisfied by implementing a simple synchronisation file in which the time spent by each measure is registered. These files can be used as a basis for executing music as auxiliary audio and presenting the right music page in the correct time instant for both image score music and symbolic music.

2.3 WEDEL distribution format, WDF, specification

WEDEL Distribution Format and language includes constructs for the integrated description of the following aspects:

- Identification
- Classification
- Protection
- Printing
- Symbolic Music
- Image Score

- Performance
- Documents
- Lyric
- Audio
- Video
- Image

In the following these aspects are shortly discussed, while a detailed view of each aspects is analysed in a separate section for its corresponding specification:

1. Identification, which allows the identification of the W D F piece. Typical identification mechanisms have to be used such as ISM N . In addition, each W D F has to provide a unique W D F ID , such as every its component.
2. Classification, which allows the classification of a W D F piece according to archive mechanisms. The information included into the classification is general, no details about the single components of the W D F have to be included. These are contained in the specific components. This classification is only for the whole object and it doesn't confused with the classification of the symbolic version, image score version, audio files, etc. which are the components of the W D F object.
3. Protection which includes the protection aspects of encryption, watermark at high level, only the codes are stored. In addition, a table about the manipulation permission is available. This part also include the aspects related to the permission of music manipulation in the several state of the W D F object. When it is demo, when it is a rented object, when it has been sold, when the renting period has been expired.
4. Printing which includes the default description for printing the music contained in the W D F object. These have to include format, presence of cover, set of documents to be printed, specific fingerprints. Details about printing of symbolic, image score and Braille can be possible.
5. Symbolic Music, which describes the scoring information, musical notation symbols, and their relationships. The idea is to allow the execution in M O O D S manner presenting the score pages with a replacement mechanism on a large set of visualization device types, allowing the synchronization of audio files provided in W A V E or M I D I formats.
 - Details for classification aspects, name of the part, and for the main score, etc.
 - Details of identification aspects ID code, W D F ID of the related main score, and part, etc.
 - The logic aspects are collected in a file for each part and one for the main score. For supporting the symbolic indexing a specific logic mechanism for identifying univocally each symbols of the music notation independently on its visual position has been developed;
 - The main score is obtained by using parts and its visualization rules coded in a sort of improved M I L L A such as in M O O D S . Visual arrangement of symbols when specific exceptions must be imposed with respect to standards defined by the rules, and the music fonts. Visual rules can be different for the main score and parts, from a music score to another. When parts are visualized distinct visualization rules may be used for formatting music according to different styles. These can be imposed by the publisher on the basis of its preferences and on the basis of the delivered music;
 - Fonts can be different from a music score to another. Standard fonts can be used. Specific fonts can be defined and attached to the symbolic part of the W D F file. The definition of new fonts can be performed by the publisher that interact with the W E D E L editor and integrator, W E D E L editor, deciding to add a custom font/symbol. Fonts include tables, font in vectorial format, fonts for the screen, and fonts for printing in postscript. The vectorial format of fonts is included into the W D F object only if needed.
 - versioning, which supports monitoring the evolution of music pieces while considering logic performance and visual evolution. Changes performed on the main scores and parts (for logical aspects) can be collected, classified and reapplied according to a sophisticate mechanism of versioning via Additional Command List, similar to what has been performed in M O O D S project and music editor. The versioning is also applied to the performance aspects, in the sense that several different version of the synchronisation files can be stored into the W D F object.

1. Image of Music Sheets, which allows to distribute images of music scores without converting them into symbolic form at. The idea is to allow also in this case the execution in MOODS manner presenting the score pages with a replacement mechanism on a large set of visualization device types, allowing the synchronisation of audio files provided in WAVE, MIDI or MP3 formats. Images of Music Sheets can be distributed in GIF or compressed TIFF formats starting from PDF, TIFF, BMP, GIF, PIC, PCX, TGA, etc. and any other image format. Images of music scores can be at different resolution depending on the purpose for which the WDF is acquired from the publishers (see the previous section for discussion). These can be from 1200/600 dpi (master image) to 100/70 dpi (computer screen resolution). The resolution also influences the printing quality and reliability/robustness of watermark. Images of music sheets have to be protected with a specific watermark. Each image has to be accompanied by a description file, which includes an ID, a reference to the WDFID, a description, a type and other information to maintain images of music sheet linked to the rest of the WDF components. Images can be of main score and of parts. Single images include a staff line (comprised of several measures) for single parts or a the single systems of parts for the main score. For each score image the number of included measures is collected. Mechanism for reducing their dimensions according to the adopted computer have to be provided. This allow to present music in image format in a suitable manner according to the dimension of the computer used for visualising the music. In addition in this manner a more detailed control on the music consumption/execution can be performed since each small piece of image have a range of included measures.
2. Performance. This aspect deals with the execution rate of music during a performance with the aim of providing on the computer screen the symbolic or the image version of music synchronously with the available auxiliary audio files or with a generated MIDI from the symbolic music. To this end, a solution similar to that has been proposed for the same purpose in MOODS has been adopted. It is based on the definition of a synchronisation file that include cross references between the symbolic/image version and the auxiliary file. This files contain the so called Execution Time Trend, ETT. It includes aspects related to the generation of sounds and for page turning during performances; These aspect put in relationship symbolic score with audio, or the image score with an audio file. Audio files can be MIDI, WAVE and MP3 in any cases the execution is performed with the WAVE format or MIDI. Each ETT has an ID, a reference to the WDFID, a description, a reference to the synchronised files and a type.
3. Documents. Each WDF file may include none, one or more structured documents. Each documents has an ID, the ID of the owner WDF, a description and a type, etc. These may include author biography, critical description of the piece, description of the music piece, description of the performing orchestras, etc. For this reason several different documents can be included for each WDF file. In general, their format can be PDF, WORD, Textual (TXT, in ASCII), HTML, etc. No limitation are imposed on their format. Documents on different languages could be included as well. This section could include also a document version of the Music score. It can be in PDF or PostScript as well.
4. Lyric. Each lyric has an ID, an ID of the WDF owner, and a description. Each music piece may have none, one or more lyrics associated with. In general, the lyric can be associated with
 - a symbolic part, a symbolic score may have a lyric line for each part. In effect, a single part may have even 4 distinct lyric lines. In this case the specific Lyric is linked by using symbolic links to the corresponding part. The single lyric line in a score can be due to the presence of refrain or for the presence of more than one voice. In the latter case, it more frequent to have different music score parts.
 - An image score music even in the absence of the symbolic parts, to read the lyric, for example for the operas.
 - The audio even in the absence of the symbolic or image score parts, to read the lyric, for example for the operas.
 - More than one version of the same lyric may be present for supporting different languages if the symbolic part is the same. If the symbolic part is different (has been modified for arranging music according to the need of the translation) a different WDF object has to be generated.
5. Audio. A WDF file may include none, one or more audio files. Each audio file has an ID, a description, the ID of the WDF owner, and a type. Their format In general, their format can be WAVE, MIDI, MP3, SND, etc. No limitations are imposed on their format, only WAVE, MIDI and MP3 file can be used for

the synchronisation with symbolic or image music. Audio files on different languages could be included as well. The synchronisation of audio file allows the adjusting of execution rate during visualisation and listening of music score with the selected audio.

6. Video. A WDF file may include none, one or more video files. Each video file has an ID, a description, the WDFID, and a type. These may be included via HTML files. No limitations are imposed on their format: AVI, MPEG, etc., size and image rate. This depends on the hardware and software available on the publisher and client sites. Video files can include their audio this could be synchronised with music score. This aspect is out of the scope of the project. With this synchronisation not be possible to adjusting the execution rate during visualisation of music score and the visualisation of video and listening of the selected video.
7. Image. A WDF file may include none, one or more images. Each image file has an ID, a description, the WDFID, and a type. These images have to be distinguished from the images of music score. The first are typically used for showing the portrait of the author/performer, the picture related to the music or opera, or performer, the home/city of the author/performer, a picture of the instrument. These may be visualised via HTML files. No limitation are imposed on their format: GIF, TIFF, BMP, PCX, etc. The same images can be referred by the document section.

Each component of the above described WDF may be missing except for some parts of the identification and classification sections. Depending on the missing parts the available functionalities of the WDF can be different. Details on these aspects are reported in the following. In addition, a WDF includes also the description of its structure.

- Symbolic-lyric: different lyric files can be referred to the same symbolic file. A symbolic part has to refer to a specific lyric file
- Symbolic-image score: this relationship is performed via the number of measures
- Image score to symbolic: this relationship is performed via the number of measures
- Symbolic-video: via http links that can be assigned to music notation elements
- Symbolic-images: via http links that can be assigned to music notation elements
- Symbolic to documents: via http links that can be assigned to music notation elements
- Image score-video: via http links that can be assigned to music notation elements
- Image score to images: via http links that can be assigned to music notation elements
- Image score to lyric: direct reference
- Image score to documents: via http links that can be assigned to music notation elements
- Symbolic to audio via performance: each audio file can be synchronised with the single symbolic score contained into the WEDEL object.
- Image score to audio via performance: each audio file can be synchronised with the single image score modelling the music sheet contained into the WEDEL object.

2.4 Identification

The Identification section of the W D F object contains several identification details. The same structure is contained into the W D F components, for instance into the symbolic main score and parts and into the image score: main score and parts. In the following the table reporting the list of fields is presented.

W D F IR		
W D F Identification Record for W D F objects and/or components		
Field	Structure	Example/note
*W D F ID	<W D F ID >	W D F ID of the father if W D F IR is into a component
ISxx1	<type> <string>	ISBN 9-384-2456987463
ISxx2	<type> <string>	ISM N 9345934-342s32
ISxx3	<type> <string>	ISRC (60 bit)
ISxx4	<type> <string>	
*Publishing Status	<enum >	published unpublished master distributed via internet... ..
*Publisher	<string>	set in automatic according to the installation
M usic G eographic A rea	<string>	A sia U SA Europe ITALY
C atalogue identification	<string>	A code
Second Publisher	<string>	A name
Server URL ,	<url>	Location download
Location Publishing	<string>	Florence, Italy
LocalD istributor	<LocalD istributorID >	A 1443d
LocalD istrib.Nam e	<string>	Ricordi, Suvini-Zerboni
*D ate of preparation	<xm l-date>	hhhh-mm-gg, date of preparation
*V ersion M ajor	<m ajor>	M ax 99, m in 0
*V ersion M inor	<m inor>	M ax 99999, m in 00000
R esponsible Nam e	<string>	Tom Kiercos
Q uality level	<num ber>	from 0 to 100

The mandatory fields have been marked with an *.

where:

- <type> can be ISBN , ISM N , etc..
- <LocalD istributor ID > is on 6 digits in alphanumeric base, for a total of 36^6 different local distributors.
- <string> is a string of characters for a maximum of 256 chars.
- A version number comprised of two numbers <m ajor> <m inor> . M ajor is the major version code and m inor the sub version identification with 2 digits over the dot and 9 after: 99.99999. Starting from the 0.00001 version. A major version is justified only when the object has had a change at component level: addition and deletion of a component. Changes of component value produce only changes in the minor version digits. The increment of these numbers are totally automatic and set by the W EDEL editor.
- <url> is the http address up to 256 characters
- <xm l-date> is a date in hhhh-mm-gg, with the separation stated with minus character
- <date of preparation> is a date automatically set by the W EDEL Editor.
- The W D F condition states if the W D F object represents a complete W D F object, or it is only a partial version or it is only an empty HEADER for promotional/classification purposes.

All the above pieces of information can be used for identifying the single W D F object into the databases, sever or local distributors. Some of this information is also used for building the code for watermarking the single object.

2.5 Classification

Classification has to allow the cataloguing of a WDF piece according to archive mechanisms. The information included into the classification part of a WDF object contains in general no details about the single WDF components. The classification details about the components are contained in specific description files associated with each component/aspects. These description/header files are moved together with the specific component file.

The Z39.50 and UNIMARK standards have been included.

All the following fields included in the classification record are much more important for Libraries, and conservatories rather than for publishers. They typically need less information for cataloguing their music. On the other hand, that information is needed when the music is printed. The information is typically included in printed music. For this reason it has to be included also into the WDF objects classification records.

The fields of the classification can be those reported in the following table. The fields included have been selected from the above reviewed classification mechanisms and formats and according to the discussions performed with the end-users which are present into the projects as partners. The classification record contains information that can be present at level of WDF object and also at level of each component.

This information can be different. The "duplication" of the WDFCR is also needed since

- the WDF object may be a unified version of several documents and may contain several already published components that present their specific classification.
- several fields can be similar. To this end an automatic filling mechanism for the WDFCR of the WDF object towards those of the components or those written in other languages is provided.
- the single components can be saved into separate elements and combined with other WDF objects.

W D F C R		
W D F C lassification R ecord for each L anguage		
F ield	T ype	E xam ple
A uthor	<string>	W .A .M ozart
*T itle	<string>	The serenade in G
Parallel T itle	<string>	Trio in G
A ct	<string>	First
M ovement	<string>	First
P ierce type or ensam ble	<string>	Sym phony , quintet , overture , aria , trio ,
*G enre	<string>	N one Baroque classical rom antic m odern ...
*S tyle	<string>	N one Bebop rock 'n 'roll rep ...
Purpose	<string>	Education effective sim plified
Extracted from	<string>
A sequence num ber	<string>	N 35 ,
P ierce T onality	<string>	G M ajor ,
I nstrum ent (if any)	<string>	
I nstrum ent T onality	<enum >	Notes : A , B , G , C
A lphanum eric num bering	<string>	K 581 ,
*U nique short nam e	<string>	H affner , prim a vera , M ozart T R I D
*O riginal Language	<string>	Unknow n I UK FR
*Language of this classification	<string>	Unknow n I UK FR GR
D uration	<U INT>	D uration in seconds
D ate of com position	<xm l-date>	hhhh-mm -gg
Époque	<year> /<year>	1970/1734
L ocation of com position	<string>
C ritical review	<string>	D escription
R eviewer	<string>
N ationality	<string>	Unknow n I UK FR
D ate of review	<xm l-date>	hhhh-mm -gg
D edicated to	<string>	I n dedica dim io padre
C om m itment	<string>	F or the Duke of Florence
F irst execution	<string>
A textual description	<string>

The above information is needed for the classification of a W D F object and its management into the database. A W D F object has to present at least a Classification Record as the above for the original language.

In the above record some fields can be missing, while others are absolutely mandatory.

The absolutely mandatory fields have been marked with an *. According to the fields of the above table:

- <string> a string of 256 characters maximum
- The Author name could be taken from a standard authority that specifies the standard names for the music authors as mentioned by Angelo Pomilio.
- Author can be author, coauthor, (anangiatore, librettista)
- Genre: opera, coro, canzone, music de chambre
- Instrument: the main instrument or it is for a single instrument that single instrument

A W D F object may have several classification records and these have to present different languages.

The classification is also present inside the single parts and main score files for both symbolic and image score versions. Parts and main score files contain also their own identification record. For example, the following figures describe a case in which a W D F item refers to a symbolic W D F file, SW F, containing a main score or a part, that includes a W D F R and some different W D F C R s, one for each language.

2.6 Symbolic Section in WDF objects

The symbolic section of a WDF includes several aspects as reported in the following table.

WDF Symbolic components	
Part	description
Classification	classification aspects, name of the part, etc.
Identification	identification aspects ID code, WDFID of the related main score, etc.
Logic	logic aspects are the music specification of each part and main score details.
Visualization	Rule for visualisation in a sort of improved MILLA such as in MOODS. Visual arrangement of symbols when specific exceptions must be imposed with respect to standards defined by the rules, and the music fonts. Visual rules can be different for the main score and parts, from a music score to another. When parts are visualised distinct visualisation rules may be used for formatting music according to different styles. These can be imposed by the publisher on the basis of its preferences and on the basis of the delivered music;
Font	can be different from a music score to another. Standard fonts can be used. Specific fonts can be defined and attached to the symbolic part of the WDF file. The definition of new fonts can be performed by the publisher interacting with the WEDEL editor and integrator, has decided to add a font/symbol. Fonts include tables, font in vectorial format, font for the computer screen, and fonts for printing in postscript.
Versioning	which supports monitoring the evolution of music pieces while considering logic performance and visual evolution. Changes performed on the main scores and parts (for logical aspects) can be collected, classified and reapplied according to a mechanism of versioning via CWF command List. The versioning is also applied to the performance aspects in the sense that several synchronisation files can be included in the WDF object..

- According to the music model adopted there is no distinction between the parts and the main score. The main score is built on the basis of its parts according to the order on which they are loaded. For this reasons a music piece comprised of N parts has N+1 files containing the corresponding the main score plus the N parts.

3 WEDELMUSIC Editor and Integrator

The WEDELMUSIC editor and integrator includes the aspects of creating, manipulating, verify, save, load, print, etc. of WEDEL objects. To this end, several aspects have to be considered: music editing, music conversion, component integration, lyric management, printing capabilities, versioning, formatting, execution, user interface, etc. These aspects are separately specified in the following subsections.

In the next Figure, the general architecture of the WEDEL Editor and integrator is reported.

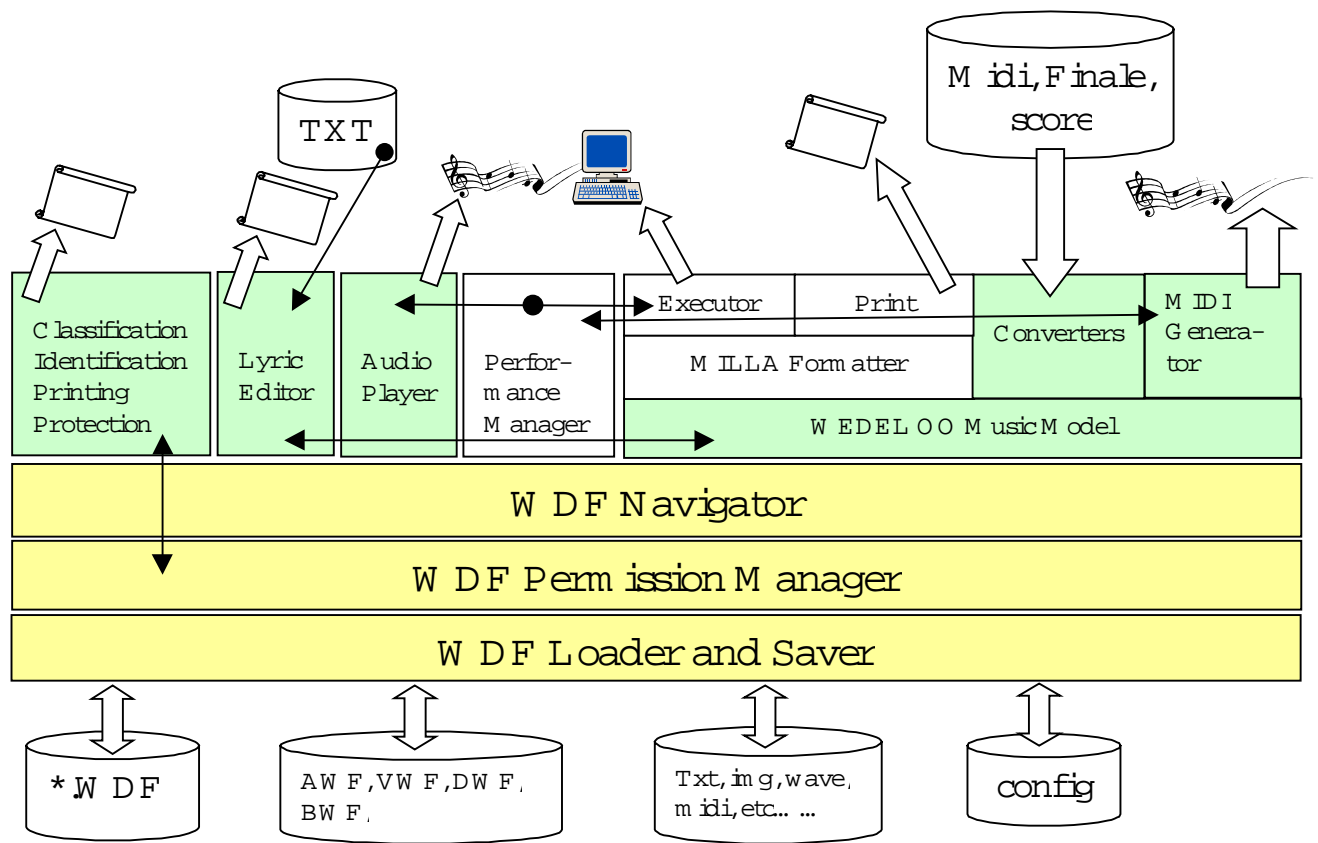
In the figure the main relationships among the several components are depicted:

- WDF Loader and Saver — A loader for the XML like format of the WDF object. It is capable of loading both encrypted and clear files. The encrypted files can be loaded only if the decryption module is present. Please see the architecture of the clients of the Local Distributor.
- WDF Protection Manager — This module has the duty of imposing the constraints specified by the WDFGPC to the tools that are based on the WEDEL Toolkit. Each operation that is allowed may have a corresponding price. When an operation stated by the WDFGPC is performed the WDF TOOLKIT has to communicate this fact to the accounting manager of the Local Distributor and to the PCMCIA manager for collecting the log of performed operations.
- WDF Navigator — a tool for navigating on the components of the WEDEL object, WDF object it includes: navigator, viewer for classification, viewer for identification, etc. It can be used for calling audio player, video player, lyric editor and Visualiser, document viewers, image viewer and for opening symbolic music editor and Visualiser or for opening the viewer and Visualiser for image score format. Some of these viewers are external standard utilities of the operating system.
- Classification, Identification, Protection, Printing Manager — for editing and visualising the corresponding aspects
- Lyric Editor — A tool for editing, importing and printing lyric. Lyric is related to the object oriented model of the music score.
- Audio Player — A player for WAVE files. It include also a run time converter from MP3 to WAVE. It is used by the Performance Manager during the execution synchronised with symbolic or image score.
- Performance Manager — A module for generating, loading, saving, defining synchronisations of executions based on either image score or symbolic formats.
- WEDELOOMM : WEDEL Object Oriented Music Model including all functionalities of music modelling, printing, playing, transposing, copying, cutting, executing, etc.
- MILLA Formatter — An engine for automatic formatting music on basis of rules. It has several sub-components for positioning, ordering, justification, beam orientation, stem orientation, etc.
- Executor — The executor for providing the right pages according to the Performance trend defined or to the basis of the Metronomic Indication. This produces the right music score pages in both cases symbolic or Image score formats.
- Print (Music) — An utility for printing music. It is based on MILLA positioning system.
- Converters (symbolic Music) — A set of converters from other symbolic formats such as MIDI, Finale, SCORE
- MIDIGenerator — A generator of MIDI sequence of commands from the WEDEL Object Oriented Music Model of the WDF object. It include orchestration aspects.

Depending on the solution chosen an MP3 reader is needed for internally converting in pipe the MP3 files into WAVE format, an operation of decompression.

For the same reasons a MIDI to WAVE or a MIDI executor is needed.

The MIDI executor has to be implemented also for generating music via MIDI from the symbolic music.



4 WEDEL Editor

The WEDEL Editor, also called WDF editor has the following main functionalities.

- Showing the WDF components in a sort of a tree
- Inserting/removing a component
- Inspecting the single component for classification, protection, ID and context
- Printing the WDF description
- Generating the WDF HEADER for bibliography purpose
- Visualizing/Editing the classification details
- Visualizing/Editing the identification details
- Visualizing/Editing the protection details
- Visualizing/Editing the printing details
- Verify consistency of the WDF object, navigating on links and verify the presence of sync files, ETT,
- Inspecting audio files such as MP3 etc by using a commercial program
- Inspecting HTML files by using a standard browser
- Inspecting image files by using a standard browser
- Inspecting video files by using a standard browser
- Inspecting DOC files by using WORD or an its visualizer
- Save and load a WDF object
- Export/import a WDF object to/from the database
- Controlling the WDF consistency of defined ID
- Controlling the protection permission consistency
- Controlling the WDF object for completeness and consistency before preparing it for the delivering or database packaging.
- Setting the default tools: music editor (WDF inside), lyric editor (WDF inside), text editor (for example a notepad), font editor (fontographer), Milla editor (for example notepad or a specific visual editor of the rule table), fretboards editor (a WDF outside editor).
- It has to be possible to open the symbolic version of the score with all its parts and at the same time to have the image score version with all its parts. In general, it is better to load only the parts needed and not all parts. This can be feasible and more relevant for image version of music scores. Since the amount of memory needed for each image can be high.
- Addition of an audio file in WAVE format
- Addition of an audio file in MP3, etc. format. In this case, the MP3 file is converted the in WAVE before the execution.
- Addition of a textual file forming from it a lyric file
- Addition of video file in several formats.
- Addition of images files in any known format.
- Addition of Document files in any format
- Addition of an image score version to a current WDF object.
- Addition of a symbolic music to a WDF containing an image music score.
- Add an image music score to a WDF containing a symbolic music.
- Visualise symbolic music and image score music on the same computer at the same time in different windows.
- Etc.

4.1 FILE MENU of WEDEL Editor

- File:New —New WEDEL objects is created. It is created in the MDS directory.
- File:Open —Open an already present on the disk WDF object. Search for a directory.
- File:Close —Close the current WDF object losing the last changes, it has to be discharged asking to the user if has to be done or not.
- File:Import from Database —Open a WDF object from a special directory/location sharing data placed from the database, see WDFIMPORT path
- File:Save — Save the current WDF object updating data. This means that each aspects of the WDF object is updated on the disk.
- File:Save as — Save the current WDF object asking for a new name. This means that each aspects of the WDF object is updated on the disk with a new name and location. The current name is set to the new name.
- File:Export to Database — Save WDF object into a special directory/location sharing data for the database. This selection is inhibited if the Packaging Check is not performed with success. See WDFEXPORT path.
- File:Print WDF — Print the WDF details: Identification, classification, protection, printing, or part of them for reference.
- File:Exit — Exiting from the application, verification of the saving of the current WDF object.

4.2 EDIT MENU of WEDEL Editor

- Edit:Undo —undo of the last delete.
- Edit:Expand All —expanding all levels and components of the WDF object tree.
- Edit:Collapse All —close all levels of the WDF object tree
- Edit:Save Workspace — save the position/size of the menus and windows of the whole application. Menus and windows non opened maintain the last values.

4.3 WDF items

The structure of a WDF object is shown with a tree that replicates the WDF structure. For each element of the WDF is possible to create a new element with NEW and ADD.

- New (WDF item)
A new element is created asking for the related mandatory information: WDF item, WDFIR, WDFCR. In addition, for documents, lyric, audio, video, in age means also to select a file. This is copied into the virtual/physical directory hierarchy of the current WDF object.
- Add (WDF item)
Add to the current WDF object an already present component on the disk. It has to be searched on the disk with classical open file dialog box. The extension of the file is imposed on the basis of the item that has to be added according to the above mentioned extensions. The navigation for adding the component start from the path stated by the environmental variable EXCHANGE PATH.
- Open
Open the selected item. This command is not available on performance file, EWF. This is also activated by clicking twice on the item with the left button.
In more details, if the selected item is a
 - n symbolic score part or main score the music editor is opened on that part or main (in editing if the permission is granted),
 - n in age score part or main score the music editor is opened on that part or main (in editing if the permission is granted),
 - n audio item the audio player is opened on the file (if permission is granted).
 - n Milla item the Milla editor is opened on the file (if permission is granted).
 - n font item the font editor is opened on the file (if permission is granted).
 - n video item the corresponding video player is opened on the file (if permission is granted)

- n document item the corresponding document editor is opened on the file (if permission is granted)
 - n image item the corresponding image viewer is opened on the file (if the permission is granted)
 - n lyric item the corresponding editor is opened on the file (if the permission is granted)
- Info View
Visualisation of related data: W D F ID , W D F IR , W D F CR if any for the corresponding component, plus specific information related to its data according to the tables reported in the previous sections
 - InfoEdit
Editing of the information View and mentioned in the previous point. For View and InfoEdit several information can be viewed or edited, for this reason a dialog box containing a listbox listing this information is reported. The user has to select the specific item to see or edit the corresponding information.
With double click or pressing a key the specific information is activated. The fields marked with * are absolutely mandatory. Specific buttons for adding and removing classification records are needed: ADD (which is a new), delete.
 - Rename
Changing the description associated to the W D F item . This is also possible by using the standard modality of windows, by clicking on the right button on the name.
 - Delete (prune)
Remove the selected item from the W D F. The file is not removed from the directory in which the W D F item and related files is included. This can be used for deleting links and making a smaller object by saving it with a different name.
 - Save
Save the single item as ?W F file according to its type. The save is performed starting from the path stated by the environmental variable EXCHANGE PATH . Once the component it is added the eventually referenced files contained in that paths have to be copied in the directory of the current W D F file. This is very important to perform successive ADD in other W D F. The Mechanism of ADD /SAVE is the only way to exchange W D F components among W D F objects.

4.4 TOOLS MENU WEDEL Editor

- Tools:Music Editor — Opening the corresponding editor. It is the WEDEL Music Editor.
- Tools:Lyric Editor — Opening the corresponding editor. It is a specific text editor for Lyric parts, as mentioned before.
- Tools:Text Editor — Opening the corresponding editor. It can be a notepad or a standard text editor for the current operating system .
- Tools:Font Editor — Opening the corresponding editor. It is a commercial font editor for True Type fonts such as Fontographer. Only TTY (True Type) font can be edited.
- Tools:Table Editor — Opening a Table editor for the font and symbols parameters.
- Tools:M illa Editor — Opening the editor for manipulating Music formatting Styles. It is a textual or table editor.
- Tools:Fret Editor — Opening the corresponding editor. It is a specific graphic editor for Fretboards for guitars, etc.
- Tools:Image Slicer — It could be a tool for semi-automatic slicing images of music scores to prepare them for the import by the WEDEL Music editor. This functionalities can be performed even manually by using a classical Image editor such as Photo.exe of Windows NT .
- Tools:Audio Watermarker — The tool for watermarking an audio file on the basis of the parameters imposed by the current W D F object loaded, implemented by the FHG IGD .
- Tools:Watermark Reader from Audio — The tool for reading the watermark from an audio file, implemented by the FHG IGD .
- Tools:Audio Converter — A commercial tool for making conversions among several formats of audio files.
- Tools:Audio Player Internal — The internal Audio player of WAVE or MP3
- Tools:Audio Player External — An external Audio Player. It can be called for opening an audio file only if the corresponding permission is available.

- Tools:CD trace extractor —A commercial or shareware tool for extracting traces from CDs.
- Tools:Image Watermarker —A tool for watermarking images of music scores on the basis of the parameters currently imposed on the loaded WDF object, or on the new WDF under construction. This is implemented by FHG IGD.
- Tools:Watermark reader from Images —The tool for reading the watermark from an image of an image score, implemented by the FHG IGD.
- Tools:Watermark reader from Images score printed —The tool for reading the watermark from an image of a printed score from symbolic, implemented by the DSI.
- Tools:Image Converter —A commercial or shareware tool for converting simple images among the several formats. The main idea is to adopt as the internal format of WEDEL the GIF or TIFF compressed.
- Tools:Video Player —A commercial or shareware tool for playing video files, such as AVI or MPEG1. It can be the classical Multimedia player or Windows.
- Tools:Browser —A commercial or shareware HTML browser for editing excerpts. It can be also an internal browser with editing capabilities.

5 WEDEL Editor Installation

The installation is performed by using ilWEDELEDITOR and more specifically by using the menu TOOL. For the installation the following path have to be set.

Tools:Setting — Setting the default tools: music editor (WDF inside), lyric editor (WDF inside), text editor (for example a notepad), font editor (fontographer), Milla editor (for example notepad or a specific visual editor of the rule table), fretboards editor (a WDF outside editor), etc. For each executable file a full path is set including the file name.

5.1 WEDEL Editor Installation

- Tools:WDF Setting — This options allow to define the directory of work of the WEDEL EDITOR :
 - MDS: directory for collecting WEDEL object, that are directories with WDF extension
 - ERROR: directory for collecting log and error log files
 - FONT: directory containing the font files used by the WEDEL Editor as standard files. Each WEDEL object may use specific internal files.
 - MIDI: preferred directory for importing MIDI files

6 WEDELMUSIC Editor

The main functionalities of the WEDELMUSIC Editor are:

- Importing files by using converters
- Exporting files in several formats if the permissions are allowed
- Save and load files containing comm and in CWF
- Navigate and manipulate the AdditionalComm and list
- Editing the single note features
- Editing the classification details
- Editing the identification details
- Editing the protection details
- Show and edit the cover page of the main score and parts
- Merging, splitting, cutting, joining, disjoin parts
- Cut, past, insert a measure
- Add, edit, remove a lyric
- Open and close all menus related to music symbols and setting
- Controlling music duration consistency
- Formatting in automatic: beaming, up/down, justification
- Execution, synchronisation, midi setting, orchestration, insertion of labels
- Jumping to top, bottom, measure, etc.
- Execution: view and listening of a synchronised audio file
- MIDI generation while paging symbolic music
- Edit and load MLLA without reloading the music
- Edit and load font table without reloading the music
- Editing the main score as well as the single parts on the same computer in separate windows but concurrently.
- Visualise symbolic music and image score music on the same computer at the same time in different windows.

Detailed functionalities is:

- Inserting most of the music notation symbols reviewed in the above section
- Deleting all the inserted symbols singularly
- Change features of the main symbols such as notes and rests
- Copy and past the single figure
- Copy and past of the single measure
- Copy and past of the single part
- Beaming unbeam ed notes and chords
- Inserting sm all notes and chords
- Beaming sm all notes and chords
- acciaccatura of sm all and normal beams, notes and chords
- inserting/deleting changing of clef at the beginning of a measure or in the middle
- inserting/deleting changing of time signature at the beginning of a measure or in the middle
- inserting/deleting changing of key signature at the beginning of a measure or in the middle
- inserting/deleting change of barlines for refrains
- passing in execution from the editing mode and viceversa
- managing up to 4 layers for each part
- managing music form multi staff instruments such as piano, arpa and Organo
- managing fretboards for guitars and similar instruments (chords)
- managing a chord database,
- providing a fretboards editor
- managing staff with 1 to 7 lines for tablatures
- managing different shapes for noteheads
- managing lyrics, up to 4 lines

- allowing the definition of generic symbols to be associated with notes such as marker, up, down.
- Using a standard font editor for producing font in standard format
- Show and edit the cover page of the main score and parts
- Transpose a music piece (a part, a measure or a group of figures) according to a new clef
- Transpose a music piece (a part, a measure or a group of figures) according to a new key signature
- Transpose a music piece (a part, a measure or a group of figures) according to a jump of tone and octave
- Opening one or more windows on the same part or main score
- Alignment of the time signatures in the main score even in the lack of key signatures
- Insertion of [] and { } brackets for the grouping of parts
- Splitting layers of a Part into single parts
- Merging two parts into a single parts with layers
- Joining Parts to define a system of parts, such as two parts for a piano part
- Disjoin Parts, separation of two joined parts into two disjoined parts. This may delete some of the joined symbols
- Managing slurs among joined parts
- Managing beams among joined parts
- Managing a database of fretboard for strings
- Save and load of chords in the fretboard editor
- Editing the single fretboard with a visual editor

Plus the following functionalities for navigating among/towards other components

- Defining links between the single music figure to the document, image, audio and video files which are present in the WDF object.
- It can be possible to define links to other WDF objects
- It can be possible to define links to HTTP addresses
- select a measure on the symbolic representation and jump to image representation.
- select a measure on the image score music and jump to symbolic representation.

6.1 WEDEL Music Editor: Menu File

It is comprised of the following functionalities

- **Import MIDI:** importing a MIDI file. This activates a standard browsing dialog box, once the file is opened.
- **Import OM R:** calling an External or Internal OM R, this functionality is left open.
- **Import Finale:** importing a Postscript FINALE file. This activate a standard browsing dialog box, once the file is identified specific parameters is available on the import dialog box (the correct extension is PS).
- **Import SCORE:** import a SCORE file. This activates a standard browsing dialog box, once the file is identified, specific parameters is available on the import dialog box (the correct file extension is MUS but other extensions have to be accepted as well).
- **Import MOODS:** import a MOODS file, if needed. This activate a standard browsing dialog box.
- **Export WDF:** Export the current symbolic aspects into a new WDF set of files. This activate a dialog box starting from the EXCHANGE PATH default path and producing a new directory with the chosen name.
- **Export IW F:** Export the current image score file into a new IDF file. This activate a dialog box starting from the EXCHANGE PATH default path and producing a new directory with the chosen name.
- **Export MOODS:** export in MOODS format if needed.
- **Export MIDI:** export in MIDI. This activate a standard browsing dialog box for Save As. (the extension is MIDI or MID I).
- **Export WNF:** to export a single part or main score in WNF format for the analysis (see specification part III)
- **Changes list:** managing the Additional Command List. This activate a typical ACL dialog form managing the list of commands, such as in MOODS.
 In the window bottom a set of buttons are present. Their functionalities are explained as follows:
Validate: validates a change to make it definitive.
Validate All: validates all the changes/commands that are present in the list.
Invalidate: invalidates the selected commands.
Undo Last: invalidates only the last command.
Flush: eliminates all the validated command starting from the first and stopping with the first invalidated command.
Filter: allows the visualization of all the command that are specified by the filtering string - e.g. all the command issued by 1st violin (Vln I).
Load: loads an additional command list saved in a previous execution, in order to reapply it to a Neutral Version.
Find: searches on the additional command list on the basis of queries — looking for all the changes performed on lectern, any addition of notes, all the deleted slurs, the changes on a specific measure, etc.
Help: allows the visualization of help.
Close: close the dialog window.

- **Save as Changes:** save a CW F file with a different name. This activate a simple dialog box in which the list of the available CW F files for the active W EDEL object are shown. The user can select to overwrite an existing one or to make a new one defining a new name. In the case of overwrite a confirming message box is opened to avoid disasters.
Print: print the current score, main or part currently shown in the window. This activate the printing manager. It is discussed into a separate section later.
- **Print parameters:** setting printing parameters. The parameters are those reported into the <MusicPrintingParameters> plus the selection between the part or the main score. See in the following for the printing parameter dialog boxes.
- **Computer View Parameters:** setting the parameters for the Computer view interface, the bounding parameters plus the distance between the staves.
- **Print Braille:** this allow to print music in Braille, see specification part III.
- **Print Braille Parameters:** this allow to set parameters to print music in Braille, see specification part III.
- **Close:** close the symbolic or image parts (SW F or IW F). If changes have been performed a message box asking for saving the information is provided.

6.2 W EDEL Music Editor: Edit Menu

- **Computer View:** This allow to pass from the Print View to the Computer View. The computer view is the classical visualisation in which:
 - In the case of main score, the left margin is imposed by the window size, and the bottom margin is imposed by the number of parts if the window size is not enough a scrollbar is added. The view is based on the basis of the computer view parameters.
 - In the case of a part, all the margins are imposed by the window size. Plus the computer view parameters.
- **Print View:** The allow to have a preview of the music page when it is printed. The view is performed according to the printing parameters: page size, margins, scales, etc. See in the following to have more details.
- **First Page header:** compose the first page of the score (main score or parts). This is available only for symbolic music. The composition consists in stating the position and the fonts of the string which are contained into the W DFCID, W DFDID, W DFPR or the component under editing. The information related to the position of elements have to be saved into the header of the object. All this information have to be considered also in the Print Manager when the symbolic is transformed in PS file.
- **Import a Part:** import a part coming from a single external file in SW F format. This is performed browsing on the disk with a standard file browsing dialog box. This action is performed only once every time the menu item is selected.
- **New Part:** producing a new part. A message box asking for the number of staff lines is provided. Valid numbers are from 1 to 7. This action is performed only once every time the menu item is selected.
- **Hide a Part:** avoid the visualisation of a part even if it remains in the model and can be played by the MIDI. Select this menu item and then select the part that has to be hidden. This action is performed only once every time the menu item is selected.
- **Recover Parts:** the hidden parts are re-visualised all hidden parts. This action is performed only once every time the menu item is selected.
- **Cut a Part:** delete a part. Each deleted part is saved into a temporary file. Select this menu item and then select the part to be deleted. This action is performed only once every time the menu item is selected.
- **Past a Part:** past the part that has been deleted. Reload the part that has been deleted from the temporary file and putting it in the last position of the Main Score. It can be moved by using a specific command and described later. This action is performed only once every time the menu item is selected.
- **Splitting Part:** dividing a part with 2, 3, 4 voices/layer extracting the selected layer. The layer is selected by selecting a note belonging to that layer. The splitting cause the production of a new part with the extracted layer inside. Select this menu item and the part from which the layer has to be extracted by using the following dialog box. The extracted layer is placed in a new part at the end of the main score.

- **Merging Parts:** two parts that present at most 2 layers each can be fused into a single part with 4 layers. The original two parts are not deleted. This operation is left to the user. The part obtained by merging is placed at the end of the list of parts. This operation is performed by selecting this menu item and then the two parts to be merged. This action is performed only once every time the menu item is selected.
- **Joining Parts:** This operation allows the inclusion of special symbols passing from a staff to another. Parts can be joined together at groups of 2 or 3 for preparing piano, harp, and organ systems of staves. After the join operation the 2-3 staff is considered as a single part for the visualisation on the window screens for parts, for print, and for movements on the main score. The Join is performed by selecting on a submenu item 2 or 3 (for junctions with 2 or 3 staves), then the parts to be joined have to be selected with the mouse. They have to be consecutive in the main score. This action is performed only once every time the menu item is selected.
- **Disjoin Parts:** dividing two staves that are joined. This is possible only if they do not present symbols that link them strictly such as beams passing from a staff to the other and slurs with the same behaviour. This is performed by selecting one of the joined parts and then this menu item. This action is performed only once every time the menu item is selected.
- **Move Parts:** this allows the user to move up or down the selected part of a place. This is performed by selecting the submenu: UP, DOWN of this menu item. Then each part selected with the mouse does a movement on the basis of the selection chosen. Several UP or DOWN movements can be done after a single selection of the menu item.
- **Move a Layer 1,2,3,4 <-> :** this allows to exchange the layer each other: a submenu with the following items is implemented 1-2, 2-3, 3-4, 1-4. The layers are referred to a part. Then firstly the needed menu subitem has to be selected then the part has to be selected via the mouse for the application. This action is performed only once every time the menu item is selected. Queste commutazioni dovrebbero valere anche per i sistemi a più staff pertanto è meglio prevedere lo sconnimento di tutti i layer. Ma non è chiaro anche il perché questo sia necessario.
- **New Measure After:** to insert a new measure after the selected one, in this case a column of measures are included. If the editor is working at level of Main Score this is immediately visible. This is performed by selecting this item and then by identifying the point in which the measure has to be inserted. Several new measures can be inserted after a single selection of this menu item.
- **New Measure Before:** to insert a new measure before the selected one, in this case a column of measures are included. If the editor is working at level of Main Score this is immediately visible. This is performed by selecting this item and then by identifying the point in which the measure has to be inserted. Several new measures can be inserted after a single selection of this menu item.
- **New Single Measure after:** to insert a new measure dis-aligning the parts after the selected one. Several new measures can be inserted after a single selection of this menu item.
- **New Single Measure before:** to insert a new measure dis-aligning the parts before the selected one. Several new measures can be inserted after a single selection of this menu item.
- **Cut Measure:** to delete a column of measures if the editor is working on the main score or a single measure otherwise. Several new measures can be inserted after a single selection of this menu item.
- **Cut S Measure:** to delete a new measure dis-aligning the parts. Several new measures can be inserted after a single selection of this menu item.
- **Copy Measure:** to copy a column of measures if the editor is working on the main score or a single measure otherwise. Several new measures can be inserted after a single selection of this menu item.
- **Copy Single Measure:** to copy a new measure dis-aligning the parts. Several new measures can be inserted after a single selection of this menu item.
- **Paste Measure:** to paste the deleted column of measures. Several new measures can be inserted after a single selection of this menu item.
- **Paste Single Measure:** to paste the deleted measure dis-aligning the parts. Several new measures can be inserted after a single selection of this menu item.
- **Import Main score image:** to import images for generating a main score image, JWF files, the classification and identifications parts have to be filled by passing via the WDF editor.
- **Import image Score Parts:** to import images for generating a score part image, JWF files, the classification and identifications parts have to be filled by passing via the WDF editor.

6.3 WEDEL Music Editor: Misc Menu

- **Add Lyric to a Part:** to add a lyric file to a part. First the identified part has to be selected. This menu item open the lyric editor from which it is possible to import a TEXTual file for building the lyric. In addition, it is also possible to make the lyric from scratch by editing it on the Lyric Editor.
- **Edit Lyric:** selecting this item then is possible to select a part with the lyric to edit it. The lyric editor is opened and the current lyric text is presented to be modified and reassigned by user.
- **Remove Lyric:** selecting this item and then the part its lyric is removed asking confirmation before to go on.
- **Open All:** open all menus related to symbols according to the last workspace configuration.
- **Close All:** close all menus related to symbols.
- **Transpose Clef:** Transposition via clef. This item open a dialog box asking for selecting a
 - the new clef, user can choose the clef from the list
 - measure (s) number, it must be inserted by user in the field
 - an interval of measures, to insert an interval user can write <start measure number> -<end measure number>
 - part number, this must be inserted by user
- **Transpose Key:** transposition via key signature. This item open a dialog box asking for selecting a
 - new key signature, user can choose the new from the list
 - measure(s) number, it must be inserted by user in the field
 - an interval of measures, to insert an interval user can write <start measure number> -<end measure number>
 - part number, this must be inserted by user
- **Translate:** translation of a piece of music. This item open a dialog box asking for selecting a
 - number of position in accord to the staff representation in the music model (-n,... -1,1,2,... n)
 - measure(s) number, it must be inserted by user in the field
 - an interval of measures, to insert an interval user can write <start measure number> -<end measure number>
 - part number, this must be inserted by user
- **Jump to Symbolic:** this is performed by opening a message box asking for the selected measure or label.
- **Jump to Image:** this is performed by jumping at the corresponding image of the same part and measure.
- **Set Link:** this is performed by opening a message box in which a string can be written stating the link that one would like to set. After this phase the clicking on a note/figure impose the link to that figure. The mentioned document has to be present and the related marker set. All the Links have to be at HTML files or at markers contained into HTML files. In this way every file contained in the WDF object can be referred from a single figure: audio, video, images, documents, etc. A so constructed HTML file can be present as a Document into the WEDEL object. To set the link it could be needed to see the list of possible links inside the WDF object, a sort of tags that can be identified. They can be fixed points such as all the documents and all the measures of the symbolic part, the parts, etc. A specific language should be defined to state these aspects.
- **See links:** this option that can be activated or not force to mark with a different colour the figures that have a link. This selection enable for the navigation via the link. This means that when the figures are active for the link the user can click on them to navigate towards the link. This menu item has to be selected every time the user would like to navigate on.
- **Edit Link:** this is performed in two phases. Firstly the user has to select this menu item. Then selecting with the mouse the figure a message box in which a string can be written stating the link that one would like to modify is opened. The mentioned documents have to be present and the related markers set. The Message Box is equal to the above presented one for setting a link.

6.4 WEDELMUSIC Editor: Symbols Menu

- **Time Signature** — This opens the following dialog box. Please note that the time indication can be inserted in several ways. After the insertion it is necessary to select with the mouse the measure that uses the time signature imposed, since the command has effect only for the selected barline/measure. The change is replicated along the music part until a change of Time Signature is encountered.

Since different parts can be present in the partition, each of which with a different time signature, it is important to understand which is the minimum common multiple of the number of measures of these different parts. This is very important for visual formatting and to present the music in a correct way.

In addition to different time signatures it is possible to find time signatures which refer to irregular values: this means that the basis unit for the measure is intended to be grouped together to form an irregular group. For example: a time signature of 3/8 should mean that in the measure is present figures for a total value of 3/8, that correspond to 1/4 plus another 1/8. This is not always true, because usually odd time signatures like 3/8 refer to an irregular group, in this case composed by 3 figures for a total value of 3/4.

In the partition "Don Giovanni", written by W. A. Mozart, there are parts written in irregular 3/8, parts in 2/4 and parts in 3/4. We can consider a base unit for visual formatting composed by three measures of the parts in 2/4, two measures for the parts in 3/4 and six measures for the parts in 3/8, since each of these measures has a real duration of 1/4.

These numbers of measures for each part can be considered a fixed unit base of alignment: this means that in a page only a multiple of this base unit of alignment can be inserted, and that justification is carried out formatting together a group of measures composing a base unit of alignment.

This is the reason for which some additional information is needed in order to evaluate the measure: in the dialog box of time signature signing a checkbox indicating that the time signature is intended as an irregular group enables another Text Control which receives in input the real duration of the measure. While the first time signature is used in the head measure of the page, the real duration for irregular time signatures is used in formatting calculation of justification and line breaking.

This second time signature has to be present and saved for each measure.

- **Key Signature** — This opens a dialog containing a list box with the following options: Major C# (7 sharps); Major F# (6 sharps); Major B (5 sharps); Major E (4 sharps); Major A (3 sharps); Major D (2 sharps); Major G (1 sharp); Major C; Major F (1 flat); Major Bb (2 flat); Major Eb (3 flat); Major Ab (4 flat); Major Db (5 flat); Major Gb (6 flat); Major Cb (7 flat); None; Minor A# (7 sharps); Minor D# (6 sharps); Minor G# (5 sharps); Minor C# (4 sharps); Minor F# (3 sharps); Minor B (2 sharps); Minor E (1 sharp); Minor A; Minor D (1 flat); Minor G (2 flat); Minor C (3 flat); Minor F (4 flat); Minor Bb (5 flat); Minor Eb (6 flat); Minor Ab (7 flat).
- **Metronome** — This opens the following dialog box. The dialog has to provide a empty line in the list box on the left. Selecting that line allows to have a time indication without a metronomic indication. In the list on the left it has to be possible to select the word NONE. In this case, the metronomic indication is given without reporting the number of figures per minute, but only the movement string. A mechanism won't indicate the for example a quarter has to be intended as a quarter dotted should be added.
- **Dynamics** — The following are all the possible values of dynamic text: f, ff, fff, ffff, fffff, ffffff, ffp, ffpf, fp, fpp, fz, mf, mp, p, pp, ppp, pppp, ppppp, pppppp, rf, rfz, sf, sff, sfff, sffp, sffz, sfz, sfpp, sfz, sp. They could be listed in a simple list box instead of a text box.
- **Annotation** — These are textual annotations. Presently it is possible to have two textual annotations. It should be possible to edit also the font among three different fonts and stating the size among four different levels implemented.
- **Generic text** — As above but centered with respect to the figure.
- **Fretboards** — A dialog for choosing a chord to be inserted is opened. It allows the visualisation of the chosen chord on the right corner. The selection of the chord is possible on the basis of the chord name, type, bass and number of strings. The search is performed on a database containing all definitions of fretboards. This is built and managed by the fretboard editor as discussed in the sequel.

- n Notes, Noteheads, Small Notes, Rests, Accidentals, Augmentations, Repeats, Barlines, Clefs, Brackets, Horizontals, Refrains, Expressions, Generic Exp, Ornaments, Fingering, Mutes, Harmonics, Breath, Glass, Strings, Pedals, Violin — Each one of these items activates a corresponding icon menus presenting a list of symbols. These menus can be moved in any location around the computer screen. They can be oriented vertically or horizontally and their position can be saved. Every time that a menu is activate it is opened in the last saved position.

6.5 WEDEL Music Editor: Format Menu

- **Check:** verification of duration consistency is performed by opening a dialog box on which one can select:
 - The measure on which to perform the check
 - The range of measures to perform the check. When the single tick is set the end number has no sense the selected measure is chosen considering the number imposed as start.

The selection between part and main score is performed by working with the editor at level of part or main score. The results stating the presence of problems are given in a list:

```
Part  XXXX, measure number Y
Part  afka, measure number 843
.....
```

The dialog should be non modal to allow the clicking on the list of problems to move the Music editor in the corresponding measure.

- **Justification:** is performed by opening a dialog box on which one can select:
 - The measure to format and on which to perform the check
 - The range of measures to format and on which to perform the check
 - The justification type: LOG or LIN
 - The justification parameter, one tuning parameter to set a major or a minor width
 - A radiobox to check and format all the part or the main score
 - Save justification setting as parameters of default. A tick in the dialog box or a condition on the MILLA module format.
 - The selection between part and main score is performed by working with the editor at level of part or main score, that is in dependance of the view that the user has of the music.

The module of justification performs also checking on the time consistency of the measures on which justification is required.

It is not out of this context to remind that single thin spaces can be manually inserted and deleted by the user and saved, so that score have always that spacing until different justification is performed. This guarantee that fine tuning of appearance is always possible. If automatic line breaking is abled the measure anyway change his width to fit the page, but the ratio between spaces, that reside between figures, is maintained.

- **Line Breaking:** It is a toggle item.
- **Beam ing:** the automatic re-beaming according to the Milla rules is performed by opening a dialog box on which one can select:
 - The measure on which to perform the beam ing
 - The range of measures to perform the beam ing. When the single tick is set the end number has no sense the selected measure is chosen considering the number imposed as start.

The selection between part and main score is performed by working with the editor at level of part or main score.
- **Up/Down:** the automatic redefinition of up/down direction according to the Milla rules is performed by opening a dialog box on which one can select:

- The measure on which to perform the UP/DOWN in position.
- The range of measures to perform the in position. When the single tick is set the end number has no sense the selected measure is chosen considering the number imposed as start.

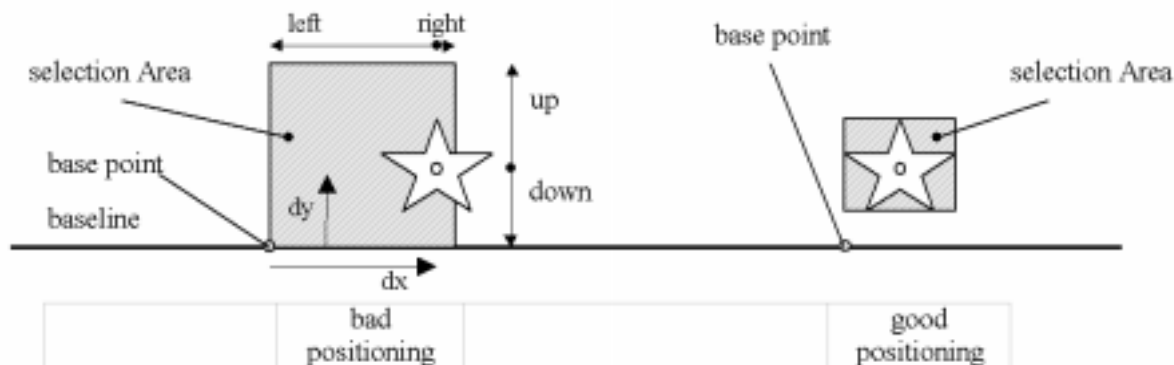
The selection between part and main score is performed by working with the editor at level of part or main score.

- **EditM illa:** starting an editing and debugging session on M illa file.
The M illa file is a standard ASCII file which is possible to be edited with a standard Notepad or any other text editor, present on every platform. There are some valuable advantages not to open another window in W EDEL Editor to edit M illa file, that means not inserting a text editor in the W EDEL editor to modify M ILLA file: the most concrete advantage is the possibility to see the changes inserted by user on rules and conditions become instantly effective on music loaded in W EDEL Editor or V iewer and not to wait to perform the operations of saving M ILLA file, close editing session in W EDEL Editor of M ILLA file and finally to reload the music. Instead of such difficult path the user open some music pieces in W EDEL Editor, then he can start a debugging session on M ILLA file, which bring to him lot of information on how formatting engine is working in background. Then, for example he can open the M ILLA file in a standard text editor, like Notepad. On the text editor he can change M ILLA conditions to perform different checks on the musical context; then he can save the modified file and in the W EDEL Editor, launch a reload command for M ILLA file and the different style of formatting is instantly effective. It is not necessary that the W EDEL Editor is in the state of debugging session for M ILLA to modify M ILLA file and reloading it.
- **Load M illa:** loading a different M illa file, if the corresponding permission is available. To this end, a standard dialog box for loading files is activated considering the extension M IL.
- **Re-Load M illa:** re-loading the current M illa file, if the corresponding permission is available.
- **>Debug/Normal:** to pass from Normal to Debugger modality for M illa and vice versa.
- **>See Invisible Rests:** to see in clear or in color the invisible rests, see in the following for details.
- **>See Achorage:** to see in clear or in color the achorage, see in the following for details.
- **Edit Table:** opening a table editor for editing and visualising the value of the font table file.

The list of symbols managed by the table is shown considering their graphic representation if it is possible.

Once a symbol is selected its parameters numbers are depicted on the right side of the dialog box. These values can be modified according to the user needs. Button Ok allow to apply the performed changes without to save the changes into the file. UPDATE makes the changes into the file if the corresponding permission is available. CANCEL return to the calling menu without any change.

There are a set of numbers to be changed in order to modify the character position in the displayed part. All the characters displayed are positioned referring to a base line. The base line is the same for all the characters from the font.



There are two groups of parameters to set for a character in a font. The first is related to the position and the second is related to the margins of the selection area.

Position parameters:

- dx -give the x position of the centre of the character from the basepoint (pixels)
- dy -give the y position of the centre of the character from the basepoint (pixels)

There are no exact rule defining the centre of a symbol. Generally it is placed in the symmetry centre of the figure but in case of non symmetric one it should be placed in the bottom-left corner.

Margins parameters are used to define the "selected area". That means a rectangle where a mouse click is considered as an action on the symbol.

- left/right/up/down - defines the distance (pixels) between the symbol centre and the left/right/up/down margin of the rectangle.

By default the editor are using valid value for all parameters, but the user should modify them for a particular stile or for adjusting incorrect positioning.

Also this file have to be modified in case new font are introduced by the user.

- Load Table: re-loading the current or a different Table file if the corresponding permission is available. To this end the standard dialog for selecting files is opened. Files have to provide the extension TBL.
- Score Excerpt: This allow the extraction of a piece of music score, an excerpt. The selection consist in choosing a piece of the screen with a square box via mouse. A music score excerpt can be extracted from symbolic and from image score formats as well. The protection manager imposes the maximum number of measures a user can grab for each time. The accounting mechanism has to consider this operation as one to be charged into the user account. The extraction generate images with fingerprint and watermark according to the protection mechanisms. Once the excerpt is extracted a standard dialog box for saving files imposing a name is opened. The File is saved in GIF, TIFF or BMP format.

7 WEDELMUSIC Editor: Execution Menu

- **Time:** the setting of the metronomic indication for execution and printing. This is performed as above described.
- **Labels:** the definition of classical labels associated with measures/barlines. In this case the following dialog box is presented. Inserting a Letter in textbox at the bottom of the dialog is possible to insert a new label. It becomes active once closing the dialog the user click a measure. On the measure the corresponding label is placed with a quite big font. These labels can be used for jumping on them.
- **Markers:** the definition of classical markers on measures. These are labels as the above one. The only difference is that they are standard symbols. To this end a special menu with these symbols is set up to active them and placing them on the music score
- **MIDI settings:** the association of standards MIDI instruments to the available channels of the MIDI device. It also set the related volume. The opening of the following dialog box on which the instruments are associated with channels selecting the right arrow. Every time an association is performed the channel is removed. The de-selection is also possible representing the deselected channel.
- **Orchestration:** The opening of the following dialog box on which the layers are associated with voices selecting the right arrow. Every time an association is performed the layer is removed. The de-selection is also possible representing the deselected layer.
- **Synchronisation:** this allow the definition of the synchronisation between the current image score or symbolic music score with and audio file. In this way the saving of an EW F file is also possible. This can be even only a simple tick to be imposed the related actions can be performed directly on the execution menu. It is only a set of a status passing from sync to play and viceversa.
- **Spoken Music:** This allow to generate a spoken description of Music. See specification part III for details.
- **Spoken Music Parameters:** This allow to define the spoken Music Parameters for example the change of the language. See specification part III for details.

7.1 The execution menu



Execution menu provides buttons for all the operations linked to the MOODS execution phase, like compilation, start or stop execution, jump and buttons for the execution speed modification. In particular from left to right we find:

- **Compilation button:** allows the compilation of score on all parts in order to provide automatic scrolling for all the parts and main score which are currently opened in windows.
- **|/| Initialisation button:** is used for loading the recorded execution time trend in order to obtain a synchronous page turning and a correct scrolling;
- **|>| Start button:** starts the execution of the already loaded score; It ask for
 - loading a specific EW F file associated with an external audio
 - loading a specific EW F file and producing the MIDI output with that
 - loading a user defined EW F file which can refer to a user audio file
 - loading a user defined EW F file for controlling the MIDI output
 - using the metronomic indication and generating the MIDI
 MIDI files can be used generated only if the symbolic version is presents and it has been loaded into the WEDELMUSIC editor.
- **|II| Fermata button:** suspends the scrolling until the director decides to continue the execution;
- **|O| Stop:** stops the current execution, for a reload or for a new starting point.
- **-3% :** Decrease the time trend of 3% with respect to the actual.

- Status and status % are white windows between the percentage buttons. These report in real-time both the actual number of beat form inute under execution and the percentage of correction, respectively.
- +3% : Increase the time trend of 3% with respect to the actual.

8 WEDELMusic Editor buttons and sym bolM enus

The music editor have a static toolbar under the menu including:



The first button activate a separate menu of execution or editing.

These is similar to those available on MOODS.

- **Message:** a message for helping the user to perform the selected operation, it describe the next step
- **Edit/execution:** a toggle button to activate the edit or execution menus
- **Top, -5, -1, +1, +5, Bottom :** navigation buttons to at the first measure of the current music piece, to move 5 measures back, one measure back, one measure forward, five measures forward and at the last page of the music piece.
- **-Pag, +Pag,** is needed to move one page forward or backward on the video. It can be used in both the visualization modality, in Computer view and Print View. -1 page: move one page after. +1 page: move of one page before.
- **Jump:** a JUMP dialog box is opened. In this way the jump can be performed by stating a specific measure number, on the top or bottom of the music score or at a predefined label. In this last case a list box showing the activated labels is presented. The user has to select of them to make the jump.

8.1 The editing menu



- **Layer:** toggle button to select the current layer on which we work for the edit.
- **Chord/note:** toggle button to select the insertion as chord or as separate notes (the button has to show a simple quarter note or a chord).
- **Notehead:** toggle button to select the current notehead among the available. The list is reported in the following. The selection of the notehead in the following menu of neadhead has to imply the change of the status style for the notehead reported in this menu bar.
- **Color:** toggle button to select among a predefined set of 16 colours: yellow, blu, orange, green, purple, light blu, black (the default), white, grey light, grey dark, etc..
- **Line style:** toggle button to select the current line style for slurs, crescendo, brackets, etc. among: continuous, dashed and dotted.
- **Auto:** toggle button, passing from Auto, up or Down positioning of steps and position of symbols. Auto is automatic according to MILLA, Up is in the direction of up the staff or directly up the staff, down is the opposite behaviour.
- **GetNext:** This allow to get (move in the currently visible page) the first measure of the next page. It is not a button of navigation through the score, but a way to form at the visualisation of the page. If possible compatibly with the width of the measure this feature add in the current visualisation another measure, exactly the one following in the score the last measure of the current visualisation.
- **SendNext:** This allow to Send (move from the currently visible page to the next) the last measure of the currently visible page. This with the previous is needed for managing the line breaking during preparation of formatting data in both Computer and Printing views.
- **-Space, +space:** insertion of micro spaces for adjusting justification. See the comments on the justification dialog box: these permit to the user to fine tuning the justified, or even not justified, measures, in order to maintain a complete control on the formatting of the score. This feature with the powerful automatic formatting engine provides a complete set for the arrangement of spaces on the screen and on the page for printing. This microspacing is influenced by the layer active at the moment.
- **Edit:** this allow to edit parameters of symbols. It is also activated by clicking the symbol with the right button of the mouse. The editing can be for changing feature of:
 - **Edit of Notes:** highness, duration, notehead, small/large, stem (up/down), layer, color, real small or grace note.

- Edit of Rests: Duration, highness, color, hidden

The rest can be: (i) visible or invisible, (ii) time consuming or no time consuming.

In the first case they are used for compensating voices when one of the two voices has a rest this is typically omitted but the justification algorithm need it, so a invisible state for that rest is needed.

In the second case they are used when there are measure starting in "levare" or for the presence of "inizio-fine" refrain in the middle of a measure. In that cases the rests have to be added to make the measure time consistent but they have not to be visible. For these reasons the combinations:

- Visible and time/space consuming (normal condition)
- Invisible and time/space consuming (hidden)
- Invisible and no time/space consuming (ghosted)

These conditions are selected from the color selection gadget in the above dialog.

- Slurs OR Square brackets on notes OR Crescendo/diminuendo: continuous, dashed, dotted, up/down, also the knots may be changed
- Barlines: the type of barline can be changed by selecting and imposing a different barlines.
- Ornaments, accents, fingering, mutes, Harmonics, Breath/glass, String, Pedals, Violin, Fretboards: up/down.
- Delete: this allow the deletion of single figure or single symbol by clicking on the screen. For deleting the measures the user has to go on the main menu.

8.2 Notes

The using of this menu allows the insertion of all kind of notes, in particular the buttons from left to right perform the following operations: Insert a Double whole note; Insert a Whole note; Insert a Half note; Insert a Quarter note; Insert a Eighth note; Insert a Sixteenth note; Insert a Thirty-second note; Insert a Sixty-fourth note; Insert a One hundred twenty-eight note;

For example

A B C (A)

3,4,5 also with (6), [6]

8.3 Small notes and rests

The using of this menu allows changing a normal note in a little one and vice versa, in particular from left to right we have: From normal note to little; From Small Note to normal; From normal note to grace note small; from normal to grace note normal.

It has to be possible to grace also beam and chords. Small and normal size.

There are also small notes that has to be considered as note of full duration differently from the grace notes. This is imposed via editing the note.

8.4 Beam and tuples

The using of this menu allows changing a normal note to a note beam, in particular from left to right we have: Converts some notes to beam; Converts a beam to separated notes. Beam a Measure, beam a Part, Beam all the score with all parts are provided into the formatting menu.

For tuples a dialog box appear to:

- insert the number: user fix the value of the tuple
- draw a line over the tuple: user can decide if it has to be with or without the line

These are presently managed as horizontal symbols.

The tuples could be also nested. This means for example that in a group with 15th a tuplet with 3 notes can be inserted.

8.5 Rests

The using of this menu allows the insertion of all kind of rest, and the insertion of spaces, in particular the buttons from left to right perform the following operations: Insert a Four measure rest; Insert a Two measure rest; Insert a Whole rest; Insert a Half rest; Insert a Quarter rest; Insert a Eighth rest; Insert a Sixteenth rest; Insert a Thirty-second rest; Insert a Sixty-fourth rest; Insert a One hundred twenty-eight rest; Insert a Multiple-measure rest; Three versions of fermata symbols with the same meaning.

Please note that rests can be even hidden, in the sense that it is needed to insert rests that do not have to be visualised. This is needed when the rest have to be inserted for satisfy the processing of measure checking in duration, but do not have to be visualised since the convention is to place a unique rest for all the measure even if the measure is not covered. This happen quite frequently in the presence of polyphonic music, when more voices are present.

8.6 Accidentals

The using of this menu allows the insertion of accidentals on notes, in particular from left to right we have: Inserts a quarter Sharp on a note; Inserts a Sharp on a note; Inserts a Three quarter sharp on a note; Inserts a quarter Flat on a note; Inserts a Flat on a note; Inserts a Three quarter Flat on a note; Inserts a Natural on a note; Inserts a Double sharp on a note; Inserts a Double flat on a note, natural down, natural up.

All the above symbols can be present in big and small size, with () or without.

8.7 Augmentations

The using of this menu allows the insertion of augmentation dots and ties, in particular from left to right we have: Augmentation Dot: inserts a single augmentation dot; Augmentation Dot: inserts a double augmentation dot; Augmentation Dot: inserts a triple augmentation dot; Insert a Tie.

8.8 Repeat

The using of this menu allows inserting repeats, in particular from left to right we have: Beat repeat, Half measure repeat, Measure repeat, repeated notes.

In the last 2 cases a dialog asking for a number has to be opened. In the first case the number is placed over the symbol, in the last case the number corresponds to the number of lines on the stem.

8.9 Barlines

The using of this menu allows inserting and modifying bars, inserting, deleting bars and deleting an entire column of bars; additionally this menu allows the Copy and Paste of bars, in particular the buttons from left to right perform the following operations: Insert a Barline; Insert a Double barline; Insert a Heavy double barline; Insert a Left repeat barline; Insert a Right repeat barline; Insert a Double repeat barline; simple dashed barline, simple dotted barline, invisible barline.

The single barline can be continuous, dashed and dotted in the last two cases these are not marking the end of a measure but are only placed for dividing measures in parts. Dashed and dotted single barlines are performed by using the line style on the status bar.

The empty button is the have the possibility of inserting hidden/invisible barlines. They are strongly useful for modern music.

8.10 Clef

The using of this menu allows inserting and to modifying clefs, in particular the buttons from left to right perform the following operations: Insert a G clef, Treble; Insert a F clef, Bass; Insert a Baritone clef; Insert a

Tenor clef; Insert An octave Tenor clef; Insert an Alto clef; Insert a M ezzo-soprano clef; Insert a Soprano clef; Insert an Octave G clef, Tenorized Treble; Insert an Octave F clef.. . The last are for Tablatures, percussions and the empty cleff.

8.11 Brackets for grouping parts

The using of this menu allows inserting new part, changing the name of the part, inserting brackets and deleting parts, in particular from left to right we have: Assign or change the part name; Brace: inserts a brace bracket used for grouping parts; Quadra: inserts a square bracket used for grouping parts.

8.12 Horizontal Symbols

This menu allows inserting the Horizontal symbols like slur, crescendo, diminuendo and others that involve a group of symbols such as octaves and 15-esimes. From left to right the buttons performing the following operations: Crescendo: inserts a crescendo symbol among a group of notes; Diminuendo: inserts a diminuendo symbol among a group of notes; 15ma is used when in over the staff and 15mb when is under. 8va is used when is over the staff and 8ba when is under.

All the above symbols (apart for the wave and the change of octave and 15-esime) can be in continuous, dashed or dotted lines. For this reason the best solution is to have toggle buttons to pass from a version to another, see status line, line style button. According to that solution the first two buttons are only for round slurs and squared slurs depending on the status of the line type.

8.13 Refrains

The list of typical symbols for Label should be acquired.

Refrain Change: inserts a refrain change symbol among a group of notes;

Also the insertion of symbols D.C. (da capo) and the D.S. (dal segno) are needed. D.S. is the jump instruction of the symbol that can be placed with the second button.

8.14 Expressions

This menu allows to insert expression symbols. These can be composed according to the rules state in Milla. It is possible to insert at most 10 different Expressions symbols on the same note including generic expressions that are expression symbols defined by the user.

8.15 Generic Symbols

For the definition of a generic expression the user has to perform the following actions:

1) Design a font with the font editor

Before using a generic expression, which usually is referred to a note, as is for signs of musical expression, the user must design the font to use in the WEDEL Editor using appropriate tools. The tools that can be used to design the new font are for example "Fontographer". In the Fontographer program the user can design the new font for the generic expression in order to fit the notation to his very particular needs.

2) Insert a parameter line in the font table

After the font has been designed it has to be inserted in a table for its correct positioning in relation to the note to which it is referred.

The table has already some spaces left empty in order to facilitate this operation; the parameters to set in the table are those referring to the default positioning in relation to the note: the user can define if the symbol he has designed must be drawn on the left of the notehead or more centered and so on. A sort of tuning is requested in this phase to adjust the symbol respect to the note. See the relative section on the font table in this document for more details.

3) Insert specific MILLA rules for the new symbol

After defining the font itself to be used for the generic expression and after tuning the default drawing parameters respect to the note, it is possible to insert the formatting rules and conditions for the correct insertion and positioning of the generic expression in various scenarios of musical context.

See Section "MILLA Formatter" for more details about the formatting engine.

For example it is possible to define the insertion above the notehead or on the stem of the note. This is a typical up/down insertion solved by MILLA in an automatic way to take in account various scenarios. Typical example is for polyphony: in this case the expression must be inserted above the note for the upper voice on the staff and below the note for the lower voice of the staff. In the following the rules above or below are written as `onstem` and `oppositestem` (thus on the notehead) because in another section of MILLA when in polyphony the stems of the notes belonging to the upper voice are all drawn upward, and the stems of the notes belonging to the lower voice are all written downward.

The token `AccentiGen` refer to a particular accent inserted by the user. To make a link between a token in MILLA and a font in the font table the user can still use MILLA rules:

```
***** RULE *****/
...
DEFSYM "Tenuto" GROUP="AccentiGen" CODE=095 DIM =1,1,3,3,-5,0
```

The token "Tenuto", which is a particular expression with the musical meaning of keeping the note (playing "legato" for breath instruments), is linked thanks to the above rule with the correct font coded with number 095 in the font table.

Following are listed some possible rules and condition of application for the group of symbols `AccentiGen`.

```
***** RULES*****/
RULEMM AccentiGen0 DEFAULT "AccentiGen" RELNOTA OPPOSITESTEM ;
RULEMM AccentiGen1 ALTERNATIVE "AccentiGen" RELNOTA ONSTEM ;

***** CONDITIONS*****/
im IF NOTE INSINGLELAYER THEN AccentiGen0;
im IF NOTE INMULTIVOICE THEN AccentiGen1;
```

More positioning conditions can be stated to move the default positioning of the symbol as in the table referred to in point 2, on the left/right or up/down (DX and DY below) respect to the musical context of various scenarios. For example if the note is on a space of the staff or across a line.

```
***** RULES*****/
RULEPOS AccentiGen2 STAC RELNOTA ONSPACE OUTSIDE STAFF DX=0 DY=0;
RULEPOS AccentiGen3 STAC RELNOTA ONLINE ONSTAFF DX=0 DY=0.5;

***** CONDITIONS*****/
posIF OPPOSITESTEM THEN AccentiGen2;
posIF ONSTEM THEN AccentiGen2;
posIF ALTERNATIVE OPPOSITESTEM ONLINE THEN AccentiGen3;
```

8.16 Ornaments

The using of this menu allows inserting ornaments on notes, in particular from left to right we have:

Trill: inserts a trill symbol with an user defined number of waves; it should be managed as a interval symbol since its length depends on the positioning of the last point. It can be a figure or a point without any reference to a symbol. This is typically called anchorage.

Turn: inserts a turn symbol on a note; **Backturn:** inserts a backturn on a note; **Turn:** inserts a turn symbol between notes; **Backturn:** inserts a turn symbol between notes; **Superior Mordent:** inserts a superior mordent symbol on a note; **Inferior Mordent:** inserts an inferior mordent symbol on a note; **Double Superior Mordent:** inserts a double superior mordent symbol on a note; **Double Inferior Mordent:** inserts a double inferior mordent symbol on a note; **Tremolo:** inserts a tremolo symbol on a note (a parameter N is asked to get the number of lines); **Glissando:** inserts a glissando symbol on a note; **Glissonda/GlissW ave:**

inserts a glissando which is drawn with a wave; Arpeggiato: inserts an arpeggiato symbol on a chord; It should be up or down with the v; Arpeggiato UP: see above; Arpeggiato Down: see above.

8.17 Fingering

The last button is a toggle button that states if the finger number inserted are rounded, non rounded or heavy rounded.

8.18 Mutes

Mute menu provides some buttons for inserting symbols related to mute. In particular from left to right we find:

- Archi: a three state button for selecting different types of mute: Arcs, Flutes, Textual version;
- Con: inserts the symbol (selected with Archi button) that specifies to put the mute on.
- Via: inserts the symbol (selected with Archi button) that specifies to put the mute off.

Please note that the mute symbol is different with respect to the first button selection – e.g. Arcs use a fork like symbol, while flutes adopt a + or – sign; the textual version is represented by con sordina and via sordina.

8.19 Harmonics

Typically, harmonics symbols can appear in different ways.

- as external marker on the notes, up or down the note such accents
- <> can appear as a notehead with stem, etc. or in chords

The idea is to leave these two symbols here. All combinations are covered when the planned noteheads are available. The diamond black and white can be used as harmonics sounds for different instruments.

8.20 Breath/glass

These symbols are only for reminding to the musicians to take care (Glasses) or a breath (comma). The last is to remember that the measure is beat in 4 beats (in N beats as state during the symbol insertion) by the orchestra conductor.

8.21 String

- I,II,III,IV ,V ,VI,VII: notes to be played with the marked string number.
- 1,2,3,4,5,6,7: in some cases the string are numbered

The last two buttons in drawings are toggle buttons that are used for selecting:

- from roman to normal numbers, there is a 1 presently.
- from alone number, rounded with square, circled numbers and heavy circled numbers. In this case the configurations are reported in the same large button.

8.22 Pedals

- Ped.: Insertion of the Pedal Symbol for Piano.
- Ped____: Insertion of the Pedal Symbol for Piano with a continuous line that graphically states the point in which the pedal released
- *: An asterisk that is placed in the place in which the Piano Pedal is released. It is typically used with Ped. While the Ped____ does not need to use this symbol.
- Harp: The Harp pedal is a drawing reporting several positions of the pedals. The Dialog reported in the following present several radio buttons. They are vertically coupled in an exclusive manner. The Default configuration is reported in the figure. The other configurations are all possible. Along the horizontal direction they do not have any relationships.

- **Piano:** The Harp pedal is a drawing depicting the positions of the pedals.
- **^:** This symbol is the H organ Toe Pedal. It is a simple up-side down big V.

8.23 Violin

Bow up; Bow down; Arco: the note must be played with arc; Pizz.: play in Pizzicato way; Use Bow Point; Use Bow Hell; Pont: the note must be played on bridge; Tast: the note must be played on fingerboard;

8.24 Percussions

NOT YET IMPLEMENTED

9 Fret Editor

Fret Editor allows visualising, modifying and creating new fretboards to realise an archive that can be used by Music Editor to insert chords configuration inside the symbolic version of music score. The aspect of the GUI is shown in the following figure:

Functionalities are:

Spin-edit # Strings

This control is often active and allows fixing the number of strings in the fretboard. This number can vary from 2 to 9.

List-box Tonic Note

All available tonics are listed with the current number of strings. It's possible to select the fundamental note. Fundamental notes are expressed in b-moll to uniform the archive.

List-box Nom enclosure

All available nom enclosures are listed with fundamental note and the number of strings selected.

Spin-edit Variant

Nom enclosure can have more variants (finger position on the fretboard) and they are identified increasing the content of this control.

Panel Preview -Edit

This window visualises the fretboard selected with previous controls and allows editing with the following modality:

- Clicking on the chord name it's possible to modify it.
- Clicking on the fretboard, it's possible to modify finger positions on strings and eventually barré; with the left mouse button user can insert a finger position on a string, move it if it's already present or delete it. To fix the barré user has to click on the start and final strings: first click with right mouse button fix the start position while a second click the final. Barré can be deleted clicking on it.
- Strings not pressed can be marked empty with the "o" symbol while mute strings are marked with "x".
- Strings pressed are marked with the number of fingers (1,2,3,4,T) and they are shown on bottom. Clicking on them a list box appears then numbers can be modified.
- Key indicators are the bridge (a black bold line in top of fretboard that defined the end of keyboard) and the specific key on the side "key number"; they are mutual exclusive. Clicking on the present indicator arrows appears and user can increase or decrease the star key.

Edit-box Comment

In this box a comment related to a particular fretboard is visualized and this can be modified.

Button New

A new fretboard with empty strings is ready and the comment is "Insert by USER". This button is enabled when an archive is loaded.

Button Insert

Add the current fretboard to the current archive. The button is enabled after that fretboard has been modified or the "New" command has been pressed while it is disabled in consultation. The name of new fretboard is controlled in order to respect the request of the archive.

Button File

A Load dialog is opened to load an archive. Default extension of the archive file is *.dat.

Button Exit

Exit and close the application.

10 Lyric Editor

Lyric Editor is a text editor and it allows managing lyric. It is possible to insert at most 4 lyric lines under the staff. User can write own or a lyric like he wrote a text using some symbols (tokens) between syllables in order to format and create the lyric line or a set of lines. This allows using an automatic mechanism to link syllables to the musical figures. The architecture of the lyric editor and the relationship with the music editor is shown in the following scheme:

The editor offers the following functionalities:

- Open Lyric: Importing a textual file in order to create a lyric file in LW F format from it
- New Lyric: Create a new lyric file/line for the music score
- Save Lyric: Saving a lyric file with the associations in a file LW F
- Save As: Save with a name. In LW F format or TXT.
- Print Lyric: Printing lyric as user wrote it
- Exit: Close the editor
- Cut: Delete a set of words or characters
- Copy: Copy a set of words or characters
- Paste: Paste the deleted set of words or characters
- View Tokens: View or hidden tokens into the text of lyric, it's a toggle
- Add: Call the auto-association manager (Linker Manager) of syllables to specific music figure (notes) on the score

The Lyric Editor can be opened from both the WEDELEditor and the Music Editor but in the first case Add Lyric function is disabled because there is no music score available to add lyric text on it. In this case the editor is a normal textual editor and visualizes lyric in text format ready to be printed if user has permissions. When Music Editor is opened then it is fully functional.

Some of these functionalities (the most used) are directly accessible by user towards a toolbar. It is shown in the following:

In the toolbar are present the "View " (Tokens) and "Add" button. View button is toggleable while Add can be disable or enable. The Lyric Editor can be opened from both the WEDELEditor and the Music Editor but in the first case Add Lyric function is disabled because there is no music score available to add lyric text on it. In this case the editor is a normal textual editor and visualizes lyric in text format ready to be printed if user has permissions. When Music Editor is opened then it is full functional.

In the the following the Lyric Editor window is shown:

11 Audio Player

Audio player is the interface to execute audio file inside the W EDELMUSIC application and it can read audio files in mp3, wave and MIDI format. It is necessary for the users that have the permission to listen an audio track and are not interested in viewing the music score and listening to it at the same time.

Its structure is shown in the following scheme:

The main functionalities of the audio player as they appear from the user interface are:

- Load: open an audio file in format: mp3, wave or MIDI
- Play: starting the execution of the currently loaded audio file
- Stop: Reset the execution to the starting point
- Pause: block execution in a point and at the release execution continues from that point.
- Jump to: jump to a point of the execution.
- Feed Forward (Go-slow): it's similar to jump function but the increment is a fixed interval.
- Rewind (Go back slow): it's similar to jump function but the decrement is a fixed interval.
- Accelerating: it is the possibility to increase the execution rate using right arrow key or clicking the related button on the panel
- Decelerating: it is the possibility to decrease the execution rate using left arrow key or clicking the related button on the panel
- Extract and save (only for wave file): it provides to extract a piece of audio file and then to save it in a wave format file (only if user has the permission to do this). To do this it's necessary to define the start and end points to cut the audio piece and the name of new file. Format for cutpoints is (min:sec).
- Time Duration: Visualizing the time duration of the audio file
- Exit: exit from the audio player application

11.1 WAVE player

This module provides to produce an audio output. He communicates with the sound card and the APU I to update the information on the main panel of the reader and receive the control command from user. It has as input an audio file in wave format. The input can be a pure wave file or a mp3 file converted in wave format in the memory of application.

The functionalities are:

- Load: open a file in wave format
- Play: Starting the execution of audio file
- Stop: Reset the execution to the start point
- Jump to: jump to a point of the execution related to the point of scale fixed by the slider
- Pause: block execution in a point and at the release execution continues from there
- Feed Forward: it's similar to jump function but the increment is a fixed interval.
- Rewind: it's similar to jump function but the increment is a fixed interval.
- BPM (or Time Stretching): it provides the change of the velocity of the execution. This function is activated when the left or right arrow keys are pressed. The left arrow key produces a reduction of velocity while the right arrow key a rise of this.
- Extract and save: it provides to extract a piece of audio file and then to save it in a wave format file. In this context the couple of cutpoints is linked to the typology of wave file. It is very difficult to fix exactly the start or the end point of a measure, so a possibility is to fix a starting time and a time interval. In this way it's possible to calculate, known the sampling frequency, the start sample and the number of samples into the defined interval.

11.2 MIDI player

This module provides to produce an audio output. He communicates with the sound card and has as input a MIDI file in 0,1 or 2 format. It's a sort of sequencer and communicates with the APU I to update the information about the execution and receive the control command from user. Also, this is the module that has to be used to listen to the symbolic version of the music piece after a MIDI conversion. The MIDI Generator makes this conversion.

The functionalities are:

- Load: Open a MIDI file in 0,1 or 2 format.
- Play: Starting the execution of audio file.
- Stop: Reset the execution to the start point.
- Jump to: jump to a point of the execution related to the point of scale fixed by the slider.
- Pause: block execution in a point and at the release execution continues from there.
- Feed Forward: it's similar to jump function but the increment is a fixed interval.
- Rewind: it's similar to jump function but the increment is a fixed interval.
- BPM: it provides the change of the velocity of the execution. This function is activated when the left or right arrow keys are pressed. The left arrow key produces a reduction of velocity while the right arrow key a rise of this.

11.3 MIDIFormatLoader/Converter

MIDI loader allows importing MIDI files (format 1) to produce the symbolic representation in the WEDEL Music Editor. Other MIDI formats (0 and 2) can be read but they must be converted before in the format supported. Loader can recognize the midi format and then start conversion if it is necessary.

Format 1 has been chosen because it's much more similar to a symbolic representation, while other formats are oriented to the execution with midi instruments.

12 F I N A L E F o r m a t L o a d e r / C o n v e r t e r

F I N A L E loader allows importing a Finale file compiled in postscript version that is converted in the W E D E L format and then visualized by the W E D E L M u s i c Editor. The guidelines is producing of a parsing mechanism to analyze the postscript file and then recognize the code of the music symbols. The goal of the converter is to produce the music information without consider the graphical aspects like position in the page, physic dimensions (stem, beam) and so on, because they are not necessary for the object oriented model used.

So, the development is done in two steps, in the first common musical symbols is considered (notehead, beam ing, rest, clef, time signature, key signature and so on) to cover the common music notation, in the latter other symbols is considered (drum notation, textual indications..). The goal is to cover all symbols used in the W E D E L M u s i c Editor.

13 SCORE Format Loader/Converter

SCORE is a print-oriented package specifically devoted to the production of complex score pages, thus to musical copying. Such orientation to high-quality graphical output makes it, together with Finale and other less popular packages, the current tool for musical publishing.

As SCORE is concerned much more with graphic rendering of a score page, the SCORE code describing music is actually a musical page description language. Despite of the naming of SCORE objects (note, rest, etc.), every object has to be considered in principle as a graphic symbol to be appropriately put on the page. Once the symbol corresponding to the object has been placed – through a coordinate system – on the page layout, following the order and rules given by the operator, a limited information about the musical relations between the symbols is retained in the code.

For instance, the relation between a group of notes and their beams can be guessed only referring to their relative spatial coordinates, thus the “closeness”, of the separate objects in the page layout. Again, “the differentiation of ties and slurs, (which are both described as curved lines) must be inferred from other information” (Smith, p.279).

In the terms of the “three contexts”, SCORE addresses mainly the visual domain, with relatively poor consideration of the logical and gestural domain, that are virtually independent.

SCORE actually uses four different codes:

- a plain ASCII code (input)
- a parametric ASCII code (output)
- a parametric binary code (input-output)
- a Postscript code (output).

As in many score editors, the plain ASCII code addresses mainly the logical domain: it contains relatively visual-independent description of the score: Pitch, Duration, Articulation, Ornamentation and Dynamics, Beams and Slurs.

This serves only as input, and lacks of a series of symbols and information that is added later, through the editor, to compose a full page of score. Such information are contained in the more complex parametric files (output as ASCII or binary files) and in Postscript files for printout.

The parametric code lists every object of the page, with the appropriate attributes described in parameters. Objects are:

- The parametric output code is normally used by SCORE as output-input code in binary form.
- The Postscript format is used by SCORE for printout.

The unit SCORES manages are pages, corresponding each to one file. Pages can be chained following links between parts, identified by a unique parameter. In the test files provided, because of the actual praxis links were not set, or in properly set, and has to be manually edited.

13.1 Loader/generator for Images of Music Scores

The loader/generator module provides to load and prepare the images used by Music Editor to visualise the music page directly from the image of the music sheet. These images are used also to realise the paging mechanism during the execution with or without audio. An image loaded has an own file with musical information in accord with the IWF format as indicated in the following table:

To define the information in the IWF file, when images are loaded by the loader module the Edit Image dialog window appears in order to fix the requested parameters: measure, url, label, metronomic indication and time signature. The most important musical informations are located in the first image in this sense metronomic indication and time signature have to be considered mandatory, they are necessary to realize the execution with images. To produce images, it's necessary to use a slicer to create the images from the main image of music sheet acquired with a scanner. So, the relationship between slicer and loader/generator is the following:

Source images are in GIF format, other formats are possible but they must be converted. The graphic resolution of image has to be at least 300 dpi, this is a good resolution because images can be manipulated without losing information. Moreover, during the paging execution in the music editor, images are zoomed in or out to be visualized entirely and adjusted to create the page in the graphic area, in this context resolution is very important to maintain the quality of images.

Subimages produced by slicer are in gif format.

13.2 The Image Slicer

The slicer opens an image file, it produces from it sub-images related to staffline and for each new image the information file. The following figure shows the step needed to create a set of images from a single part:



Slicing criteria is different if main score or single parts are considered. In fact for main score, each image has to contain a staffline system while for single part each image is a staff (see the figure).

It's possible to cut image both manually and automatically. In the first case the user fixes the cutpoints which define the image area including a staff or a system, in the second selection and extraction is remanded to an automatic staff recognition and identification using Optical Music Recognition techniques. In this case image is analysed to find positions of staves and then cutpoints are calculated. It's also possible to correct manually cutpoints defined by the automatic process.

In the extraction step, all the images obtained are saved on disk in gif format file and for each image extracted user has to fix the name of instrument (if it's a single part), number of the staff, number of measures, start and the number of measures in it. These informations are used to define the name of image in accord to the table reported in the previous section (list of files).

In the following figures, it's shown which are the relationships between images when main score or single part is considered.

13.3 MIDI Generator

This module creates a format 1 MIDI file from a main score or a single part score in symbolic version. It browses in the object structure of music translating in midi.com and the music information. The format 1 is the most used and nears to the symbolic representation, in fact there is a correspondence between midi tracks and staves. Thus, it's possible to produce without problems a single part or the entire piece, to associate an instrument, set the channel and volume for each track.

Since MIDI language is an execution-oriented model of music, translation of a symbolic version into MIDI isn't complete.

Not all musical aspects have a direct MIDI description for example ornaments, slur, dynamics, pizzicato, slapping, accents and other effects, so conversion needs to use a sort of specific translation rule for each of them.

To reproduce the pizzicato effect, the only way to realize it is to use an appropriate instrumental voice for example PizzString (in accord with GM standard), so when a string section has to play in pizzicato way it's necessary to change voice temporary and then return to the previous. Moreover the voice change can request a new set-up of voice parameters.

Ornaments are more complicate to manage, because a way to translate them in MIDI is the expansion of semantic meaning of the symbol.

Dynamics are not absolute, because some musicians could decide to play a piano like a mezzo piano.

These examples show how MIDI is poor and not adapted to describe all the aspects of music, but using some artifices or specific rules it's possible to cover a big part of them and generate a good MIDI file.

In this context, midi file quality depends on how many musical details are considered and for this reason MIDI Generator try to cover the most important music symbols (ornaments) and more useful effects (like slur, dynamics, some accents). Other aspects like reverb, chorus and sound effects to add to a voice are often strictly linked to capabilities of the midi instrument (electric keyboard, midi expander and so on) and for this reason they can be considered using appropriate and professional applications.

14 PrintManager

- Printing symbolic music, main score and parts
- Printing symbolic music, main score and parts with watermark and fingerprint
- Printing image score music, main score and parts
- Printing documents of the WDF object
- Printing the coverpage of the main score and parts
- Printing lyric with fingerprint
- Printing classification and/or identification issues
- Printing schema of the WDF and related details
- Setting the default parameters for printing music scores
- Editing printing parameters for the main score and parts
- Coverpage settings of the main score and parts
- Printing preview
- Definition of the printing parameters for the ready to print parts of the WDF object

When the user decide to print something he can modify the page shape setting if the permission allow him to do that. In this order the "OK" button should open the window presented in the last paragraph (Printing Parameters). All the parameters should be evaluated in the printpreview modality from the music editor.

For the whole part the available parameters are:

- Left, right, top and bottom margin
- Page format
- Magnification
- Number of systems to print in one page
- Distance between the staves
- Insert or not the title (a text field) in the top of any page
- Insert or not the page number in the top of any page

For the single part the available parameters are:

- Left, right, top and bottom margin
- Page format
- Magnification
- Number of staves to print in one page
- Distance between the staves
- Insert or not the title (a text field) in the top of any page
- Insert or not the page number in the top of any page

If print empty page was selected the user may set:

- Left, right, top and bottom margin
- Page format
- Magnification
- Number of staves to print in one page (for single part)
- Number of systems (for main score)
- Distance between the staves
- Insert or not the title (a text field) in the top of any page
- Insert or not the page number in the top of any page
- Number of pages to be printed

14.1 First Page Setting

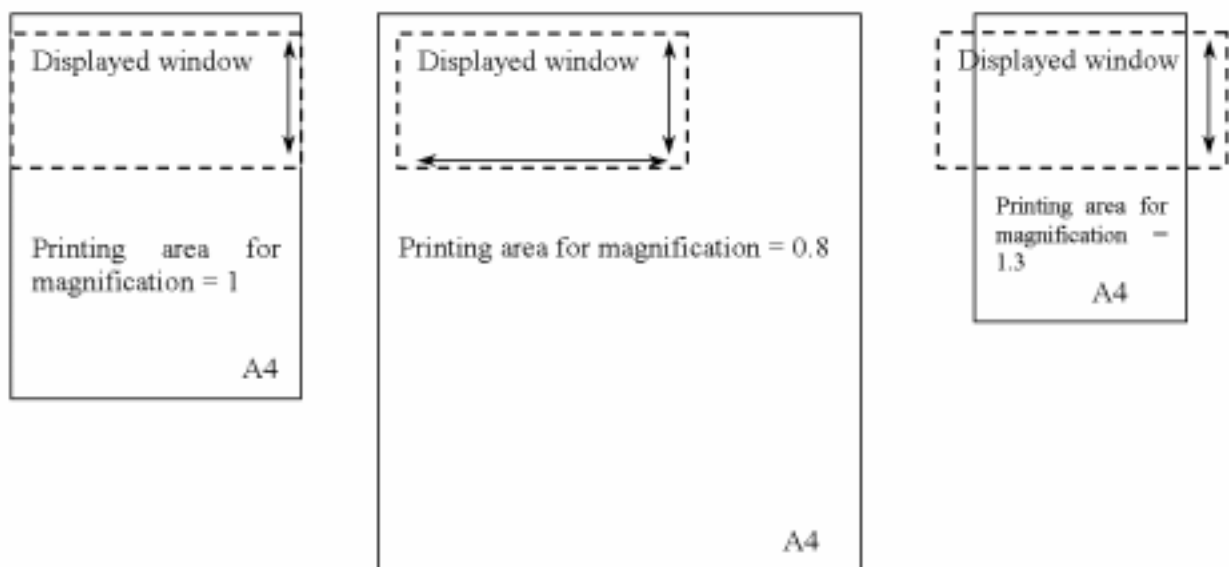
The first page printed contain (in top) also some information about the musical area like the title, the publisher etc. This information should be also displayed and printed from a PS file produced by the publisher in order to allow them a highest personalisation.

14.2 Printing preview

Since W EDEL Editor is a very powerful tool for the editing of the music there is a separate editing session for the printing of music sheets, with a formatting approach especially orientated to the printing of the music page. Formatting for the screen presents several differences to the format for the printed page. The main difference consists in the change of the point of view : in fact while on the screen the formatting lead to change visual presentation with the view , even often if the main window is often resized, formatting for the printed page means to keep the size of the canvas in which objects are put fixed and not view dependent.

In order to allow a perfect correspondence between the displayed data and the printed data the printing module allow to the user to have a preview of the sheet selecting "Preview " button.

The preview gives to the client the possibility to change the justification since the printed sheet have to be in a professional format. The principal parameters that change the views is the magnification. In order to solve the problem a virtual page is considered under the displayed one.



If an A4 page is considered the displayed window show a different part (bigger or smaller) from the page. The magnification 1 should be created in order to reflect a correspondence 1:1 between the width of the displayed window and the A4 page. Obviously the displayed window have the scrollbar in order to cover all the virtual page to be printed.

Several parameters can be fixed, which helps to delegate to the system some decisions on the layout, keeping the possibility of changing them if manual adjustment is required. For example: automatic line-breaking of the page, necessary when finally the page is printed since professional layout of music sheet is required, also to make the reading of the music easier; justification and parameters of justification, for example linear or log scale justification type and related tuning parameters.

The editing session for the printing is very similar to the standard session on the screen, but the formatting parameters like spaces and number of measures on the line is especially orientated to the sheet page. This means that the user have a particular view on the music piece with a one to one ratio to what finally the printing session generate on the page.

Please note that the parameters used for formatting music in the printing preview section are saved into the symbolic file separately from those which are used for formatting music when it has to be presented on the screen.

15 M ILLA Form atter

M ILLA stands for Music Intelligent Formatting Language.

The main functionalities of this module is:

- Reform atting music piece according to a modified style in M ILLA
- M ILLA has to include most of the most important music symbols
- Justifying the music piece: linearly, log according to a specific variable scale
- Justifying the single measure (column in the case of main score) independently on the others
- Justifying the whole part
- Save and load the justification imposed
- Print score with the justification performed
- Managing the alignment among different layers in the same part of measure
- Managing the alignment for the main score among parts and layers
- Managing the line breaking for single parts
- Managing the line breaking for the main score
- Inserting positive and negative spaces for manual adjusting main score and single part justification
- Automatic consideration of the bounding box of the first figure of each measure
- Defining justification of the main score and parts independently
- Automatic/manual beam ing (grouping and slope) according to rules
- Automatic/manual positioning of symbols according to rules
- Automatic/manual positioning ordering of symbols
- Managing the rules of user defined new symbols, generic symbols, as above
- Editing M ILLA rules for custom ising the form atting style
- Checking the duration consistency of the single measure
- Checking the duration consistency of the single part
- Checking the duration consistency of the single layer/voice
- Checking the duration consistency of the whole score

16 Performance Manager and Executor

The main functionalities is:

- Synchronising audio files with symbolic parts and main score, manual operation.
- Synchronising audio files with image score music, manual operation.
- Executing music by providing the right page in the right instant and showing the execution point with a certain approximation according to MOODS modality (see MOODS user manual). This has to be done by using both image and symbolic formats.
- Executing symbolic music by using audio from a MIDI file
- Executing symbolic music by using audio from and associated audio file
- Executing image score music by using audio of an associated audio file
- Executing image score music by using MIDI audio generated by the symbolic version
- Increasing/decreasing the velocity of execution up to the 50 % , step of plus/minus 2-5 % each. This has to be done by using both image and symbolic formats.
- Changing the metronomic indication for execution. This has to be done by using both image and symbolic formats.
- Setting MIDI parameters for specific MIDI instruments, orchestration
- Executing audio files without symbols music as they are. This can be done with specified players of the WDF editor.
- Setting labels and jumping to these labels during the execution and editing.
- Stopping the execution and continue the execution after stop. This has to be done by using both image and symbolic formats.
- Restarting the execution from a measure number or from the first measure. This has to be done by using both image and symbolic formats. In the case of images the restart is from the image/page containing that measure. Also the audio restart from the corresponding time instant/sample.
- Restarting the execution from a searched page. This has to be done by using both image and symbolic formats. In the case of images the restart is from the image/page containing that measure. Also the audio restart from the corresponding time instant/sample.
- Moving backward and forward along score looking for the new starting point. This has to be done by using both image and symbolic formats.
- Leaving the execution to return in the editing mode. This has to be done by using both image and symbolic formats.
- Selecting the specific ETT/EF file on the base of which the execution can be performed. This has to be done by using both image and symbolic formats.
- Executing music may be implemented by considering refrains explosions or implementing them as jumps.

During EXECUTION the page turning is automatic in the sense that musicians do not have to worry about it; the system provides the right page at the correct time.

The rate of music execution is initially set on the basis of the metronomic indication in terms of beats per minute. This ideal trend can be adjusted in real time by increasing/decreasing the execution rate by a given percentage. The adjustment can be easily made by comparing the position of the line marking the ideal execution instant on the score (the central line of the triple vertical lines) with the sound produced by the orchestra. This implies that the person devoted to this work has to be capable of reading music and following the score on the basis of the sound. For musicians, this is a trivial task. The archivist typically follows the music on the score during rehearsals and performances as a sort of quality control on musicians and on the scores prepared.

A different approach can be based on following the conductor's movements with a video camera, but it is more critical since the conductor does not mark each beat with a gesture. For example, when a special interpretation is required from a certain part of the orchestra, the conductor uses the hands to depict the desired effect, disregarding the general movements.

The automatic page turning presents several advantages, including: (i) the musicians and the conductor do not lose their concentration because of page turning, (ii) the avoidance of noise produced by turning pages, and (iii) the reduction of discontinuities in the sound caused by turning the page. The latter is presently reduced by trying to ensure that rests occur in the last measure of the page. This solution is obviously not always feasible, and it depends on the part and on the music. This is the reason why several pianists have someone to turn pages for them, and why, when two musicians read music from the same lectern, the one on the left has to turn the pages while the other continues to play.

The image displays two examples of musical notation. The top example shows five staves of music, each with a measure number (22, 26, 30, 14, 19) indicating the start of a new page. The bottom example shows a multi-staff score with parts for Violin I (Vcl I), Violin II (Vcl II), Viola, Cello (Cel), and Double Bass (Dbl). A vertical blue line indicates a page turn, and a red vertical line indicates the end of the page. The notation includes various musical symbols such as notes, rests, and dynamic markings like *pp* and *f*.

16.1 Synchronisation

During synchronization an ETT table is generated to store the effective time duration of single measures that are produced by the corrections of user in order to maintain aligned audio and video execution.

The content of table is:

- Name of score

- Number of measures in the score
- Time indication for each measure in the following form at:
 1. Progressive number of measure
 2. Time duration of measure expressed in millisecond
 3. Progressive number of audio fragment related to measure

16.2 Reproduction

During the reproduction, system uses the information of the ETT file to maintain audio and video aligned, so using acceleration and deceleration key it's possible to modify the execution rate. To make this it's necessary to realise a feedback mechanism between audio execution and scrolling on video and in this sense the audio fragment number plays an important role.

In fact this value allows linking the two processes each other as shown in the figure. During execution, the position of the current fragment is requested measure by measure and compared with the value stored for the current measure. If there is a big difference between values, system makes the necessary corrections adjusting the scrolling velocity for video execution.

Moreover this method can be used to realise some useful function as "jump to measure", start from measure.