Implementation and Interaction Issues in Digital Music Libraries

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Abstract: - The digital format of music led to the necessity of creating big music libraries in the Internet, which provide the user with great possibilities of acquiring and listening to music. These Digital Music Libraries (DMLs) should fulfill the user communities' needs. Since DMLs do not deal with pure text, but with sound and its several representations, special treatment is needed during their development. This paper presents the crucial issues concerning the implementation of a DML and the user-DML interaction. The implementation issues are categorized in a useful framework taking into account the keys of success of the most popular DMLs worldwide, while the interaction issues are applied on MELIRIS music repository.

Key-Words: - Digital Music Libraries, Music Search, Interaction, Computer Music Interfaces, Music Database

1 Introduction

During the centuries, music recordings and productions worldwide have created a vast collection of music resources, which lie interspersed in different media on earth. Several years ago, it would imagine impossible to organize suitably and make accessible to any interested user all this huge volume of music data. However, with the advent of new technologies, the digitization of sound gave new perspectives and capabilities to the music community. The growth of Internet, the small (in size) digital music files, the disks of enormous capacity and the development of computer music led the scientists to focus their efforts in organizing great music collections, which are accessible from the Web. The **Digital Music Libraries** offer their users new ways of interaction with music repositories and music stores online. Some of the capabilities of Digital Music Libraries are: classification, filing and sharing of music, music information retrieval etc.

Nowadays, there is a great increase in music distribution over the Internet. This phenomenon is common in many countries and therefore involves many issues such as: ways of distribution, music format, organizing music and copyright issues. The revolution in music prototypes (especially the MP3 music format) urged many people to turn to the Internet for free and easy-to-find music. Music files can be downloaded easily from the Internet anywhere in the world and be burned into a CD or DVD or transferred to a friend via usb-sticks. Music is also widely available as streams in Internet trough various services such as MySpace, YouTube and Spotify. Internet also is full of questions that what is legal and what is not, because exchange of files is hard to supervise and the laws between countries also differ.

All the legal services are constructed around a digital music library, containing millions of songs. Vast music libraries are easily accessed through Internet from users and serve as the ultimate way to find and listen to the music they desire. In this paper, apart from the popular commercial digital music libraries, the MELIRIS music library is presented (MELIRIS is the result of scientific research on chromaticism of music in the Computer Science Department – Aristotle University, Greece) [1]. Implementation issues on Digital Music Libraries are discussed in a proposed framework. Moreover, the interaction between the user and a music repository is another subject presented in this paper.

The structure of the paper is as follows. In section 2, terms and definitions related to digital music libraries are explained, together with the presentation of the most well-known Digital Music Libraries on the Web. Section 3 presents the three ways of music distribution over the Internet. The issues concerning the implementation of a Digital Music Library in a framework, as well as a short discussion on XML's role is presented in section 4. Finally, section 5 presents the MELIRIS Digital Music Library and the interaction between the application and the user.

2 Digital Music Libraries

A **library** is defined as a catalogued repository of mass produced physical objects (books, journals etc). It is local and generalized and is supported as a line-item in an agency, institutional or corporate budget. It is a specific place with a finite collection of tangible information and it is geographically constrained [2].

However, things have changed and nowadays, besides the conventional libraries, another source of accumulated knowledge has become available. The enormous amount of information that exists on the Web has transformed it to a universal public information repository. **Digital libraries** are a set of electronic resources and associated technical capabilities for creating, searching and using information. In this sense they are an extension and enhancement of information storage and retrieval systems and support the analysis and processing of information [3]. The **content** of digital libraries includes data, metadata that describe various aspects of the data (e.g. representation, creator, owner, reproduction rights) and metadata that consist of links or relationships to other data or metadata, whether internal or external to the digital library [4].

Digital libraries are constructed, collected and organized, by (and for) a community of users and their functional capabilities support the information needs and uses of that community. In this sense they are an extension, enhancement and integration of a variety of information institutions as physical places where resources are selected, collected, organized, preserved and accessed in support of a user community.

Digital libraries can contain one specific type of data or many types of content. It depends on the scope it serves. Digital libraries with mixed type of content serve general needs. For example, an integrated e-culture system about navigation through various e-culture objects (literature – text, gallery – images, and music) serves as a projection of cultural heritage and is described in [5].

A **Digital Music Library** (DML) is a digital library for music content. DML's have the following features:

- Digitized materials are delivered over a network (but not necessarily over the Internet)
- Use technology to allow easy access to the material
- Contents are stored as a stand-alone collection
- Allow for simultaneous retrieval of information in multiple formats (audio, visual, textual)

A digital music library requires addressing complex issues of description, representation, organization, and use of music information. The fundamental question to be addressed is the nature of associations that exist among various types of musical objects.

Examples of well-known music repositories over the Internet are next presented.

2.1 iTunes

iTunes is considered to be the most popular example of a music repository. It is a digital media player, created by Apple Inc., which can be used for organizing digital music and video files. The application also comprises an interface for managing the popular devices of the same company: iPod and iPhone. Moreover, iTunes has the capablitiy of connecting to the online iTunes Store via Internet for purchasing and downloading of music, videos, TV series, applicarions, iPod games, audio books, several podcasts and ringtones. If we consider strictly music, then iTunes is a "digital jukebox" for organizing, sharing and listening to music [6].

Apple presented iTunes for the first time in 9 January 2001 at Macworld Expo in San Francisco. The latest release is version 8 (September 2008). iTunes is available for MAX OS X, Windows Vista and Windows XP operation systems. All Apple personal computers come with iTunes preinstalled, as well as some HP and Dell laptop computers. Although Apple does not provide special editions for Linux, iTunes can be installed and function through the Wine application.

Fig. 1. Sorting by genres in iTunes.

2.2 YouTube

Today YouTube it is viewed more than 100-million times a day and has become one of the most spectacular success stories of the internet in recent

years. But the dazzling influence of the video file sharing website YouTube.com may have only just begun, after the site announced plans that observers say could revolutionise the music industry and threaten even the online music giant iTunes.

YouTube's popularity has been based on the facility it offers users to post short home videos, usually of about five minutes, on the site, which other users can view, link to and share.

YouTube's plan to provide "every" music video free is a "nail in the coffin" of the paid-for online content business model and potentially threatens the dominant position of Apple's iTunes. The video filesharing website, where 100m clips are watched every day, is in talks with Warner Music and EMI to offer music video downloads for free.

2.3 MySpace

Myspace is an American internet community. And it is maintained by a company of same name located in the West Hollywood in the state of California. It is a social networking website, which allows the user to create their personal profile pages, blogs and connect with friends and generally other users. From the view point of music it is also an excellent place for bands to promote themselves and their music. The easiest way to find artist of preference is to find their myspace page trough google. It is also possible to search trough myspaces own search option but it usually provides the user with lots of noise, consisting also from other user profiles which don't include the music looked for. Myspace is a very easy place to start to get to know to an unknown band and also from the artist side, a very popular place for new artist to try to promote them worldwide. However, independent artists should be aware that these structures may be redefined by processes which do not involve them [7]. MySpaces CEO Chris DeWolfe has recently announced that the social network would soon be launching a full-scale music service as part of a joint venture with three of the four major labels, UMG, Sony BMG, and Warners as minority owners, with EMI still negotiating [8].

2.4 MEL-IRIS

MELIRIS is a vast online DML, which is created by its users. The application has been created by the Computer Music Research team at the Computer Science Department of the Aristotle University of Thessaloniki, Greece. The application can be found at http://nomos.csd.auth.gr:8080/meliris. The users can download the latest version of the MELIRIS client application from there.

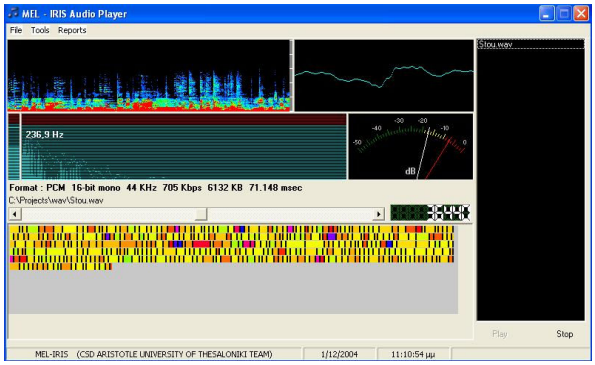

Fig. 2. The Interface of MELIRIS V.2

The client application, which runs locally on user's PC, allows the user to upload any number of songs, which are added to both his local collection and the full database of all the users at the server. The main function of MEL-IRIS is the chromatic analysis of songs and the creation of a real-time visual representation that combines colours and feelings by using psychoacoustics [9]. The data processing, the music classification, the executions of the algorithms and the process of chromatic analysis take place in the server.

Each registered user has access to all the songs of the central DML, concerning both their audience and the statistics that result from their chromatic analysis. This particular analysis is a semantic one. That allows MELIRIS DML to provide many functions as: indexing, classification and MIR tasks (comparison, pattern recognition, melodic sequence prediction and color-based searching) [10]. The interface of the application (Figures 2 and 3) is easy-to-use and offers the proper menus and commands for the aforementioned tasks.

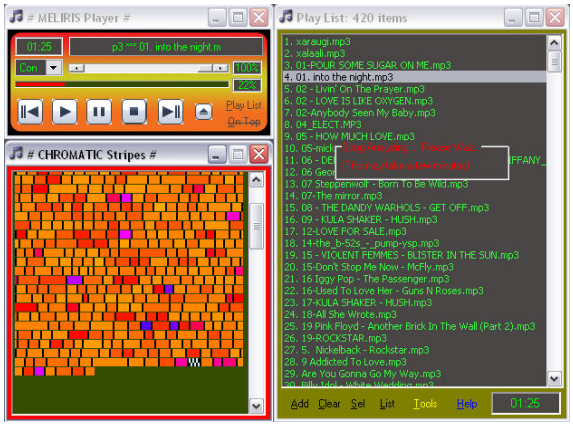

Fig. 3. The Interface of MELIRIS V.3

3 Ways of Music Distribution

3.1 Music Stores in the Internet

It is possible to order albums in their traditional form (cd, vinyls) from internet and deliver them by mail. Internet also makes it possible to order the records straight from the record company or even straight from the artist himself. Also, buying records secondhand is very easy trough auction type of services such as eBay.

The most common way, however, of buying music nowadays is in digital form in internet music stores. One can pay for the music file and then legally download it to the computer and own it. The customer is allowed to burn the downloaded songs into a compact disc for own use. Ten years ago, in 1999, "e-music" accounted only for 0.2% of music sales [11]. However, the potential is obvious today. Moreover, vinyl records are coming back to fashion and so many new vinyl albums include a code with which the buyer can download the songs of the album legally from internet in a digital form.

3.2 Peer to Peer

Peer to peer also known as p2p is a computer network connecting the participants of the network straight together without using an external server. Peer to peer method can be also used efficiently for file sharing. Trough peer to peer clients every user can upload their own files and other users can download them anywhere in the world. Trough peer to peer clients it is very easy for a normal internet user also to obtain illegal music files, but in most countries the copyright laws are not yet so strict. Ignoring the legality of the content here, p2p systems became very popular and useful for many people. As Dave Winer states: "the P inP2P is for people"[12].

Bittorrent, is a popular peer to peer protocol, through which one can download a link from internet leading to a downloadable file uploaded by other users and download it using a bittorrent client. Using Bittorrent it is possible to download files without necessarily sharing anything yourself with others, besides the time you are downloading the file, when other people can download the part from the beginning of the file from you while you are still downloading the rest. Lots of digital music files are available trough bittorrent. Other popular peer-2-peer services are: BitComet, Napster (the old closed down format), eMule, LimeWire etc.

3.3 Streaming

A lot of music is available in the internet through streaming also. Streaming is a multimedia that is constantly presented to the end user and no files are permanently downloaded to the receiving computer. Streaming media is the remarkable technology that allows a web site visitor to click on a button and seconds later listen to a sporting event, tradeshow keynote, or CD-quality music [13]. Usually in stream based services the files are uploaded to the media library on the services server by the users, when in many cases it is arguable if the uploader legally has the rights to upload the piece of media in hand. Many streaming based services are internationally popular and have millions of every day users, such as youtube and myspace. Also, Internet radio is mainly based to streaming.

4 Implementation Issues in DMLs

4.1 Creating a Digital Music Library

A single musical work can be manifested in a range of physical formats: as one or more scores, sound recordings, and video recordings, each of which may exist in multiple digital formats in a digital library system. These manifestations all share some properties of the original work but also possess unique characteristics. A bibliographic search for music typically involves both "global" work properties and "local" characteristics of its various manifestations: names of composers or performers, musical genres, styles, keys, copyright information, instrumentation, structure, media formats, and various types of publication information.

The first consideration when constructing any digital library is acquiring the source material. For a music library—particularly a library of popular music—the principal sources are printed and recorded music. A third source, which is particularly important for research libraries, comprises textual information on musical topics—biographies of composers, treatises on music theory, and so on.

Often the work involves more than simply creating a high-fidelity copy of the original recording. New technologies have made it possible to "clean" the sound of recordings by filtering extraneous noise—the clicks and pops of 78-rpm recordings, for example—with minimal loss of musical content. Typically, a preservation master is made of the original recording and the filtering is applied to service copies destined for public listening. Once the sound has been captured, it can

be stored on a variety of media: recordable CD-ROMs (CD-Rs), tape, and hard drives used to be the most common [14].

To save space and gain more flexibility, the captured media should not have a large size. Thus, the audio **compression** is an important task for creating music libraries. The basic task of a perceptual audio coding system is to compress the digital audio data in a way that (a) the compression is as efficient as possible, i.e. the compressed file is as small as possible and (b) the reconstructed (decoded) audio sounds exactly (or as close as possible) to the original audio before compression [15]. The MPEG Layer 3 (aka MP3) is the most commonly used compression technique for music. Digital audio projects require computer equipment, software, and—depending on the type of source recordings—audio components. Once the sound has been encoded and placed on the server, it is ready for access by the public.

Most streaming formats allow sound to be delivered over the network at different speeds. The higher the rate of transmission, the better the sound is, since faster speeds allow more data to be sent in real time through the network, and the increased data yield higher fidelity. Faster transmission speeds therefore require larger sound files, which in turn require larger amounts of storage space. Advances in network speed have come quickly. Now that most dormitories have Ethernet access and a growing number of home computers are connected to the Internet using relatively fast cable-modem and ADSL lines, students find low-fidelity streams unacceptable. Also, large audio files can now be stored easily on large, relatively inexpensive server drives.

4.2 Ten Crucial Issues for Implementing Successful DMLs

A Digital Music Library can be created in various ways and by using different technologies. However, there are some rules – suggestions that the creators of a DML should be aware of. The authors try to categorize these important issues in ten factors that affect a DML, in order to suggest a framework for the development of Digital Music Libraries.

1) **Rich Content.** A proper DML should contain a large amount of digital music data, which have to be well organized and effectively managed in a database. Completeness plays maybe the most crucial factor for judging the worth of a DML. If the collection does not have a high level of completeness in a particular area, the quality of the entire collection is diminished [16]. The creation of the collection contains several processes, such as: music digitization, compression, registration in the database and metadata recording.
2) **Easy-to-use Interface.** Users of a DML should navigate easily in the music database and extract the desirable music information. An intimate user-friendly design combined with an organized music database with flexible queries could bear amazing results. Apple iTunes Music store is an example of a powerful combination of a massive song catalogue and an easy-to-use interface. Moreover, Apple differentiates itself with exclusive content, community tools and one of the largest audiobook collections [17].
3) **Copyright Issues.** Great attention should be paid to the legality of the distributed content in a Digital Music Library, concerning both the copyrights of the musical works, and the rights that the database users acquire upon them. Electronic distribution of digital content in general involves numerous threats and therefore privacy – enhancing DRM models are necessary to establish copyright protection [18].
4) **Visual Representation.** Music can be represented in numerous ways in a Digital Music Library: facsimile images of scores, the internal representation of a music editing program, page images typeset by a music editor, MIDI files, audio files representing sung user input, etc. [19]. But, apart from music itself, the visual representation of music metadata plays an important role for the user of the Digital Music Library. Splendid graphics for the essential representation of the collection (e.g. in classification tasks) result to a satisfactory web music experience for the user.
5) **Autonomy.** It is crucial for a DML to be able to offer the whole package of the music experience to the visitor (not only part of it). For instance, the existence of an embedded Media Player in the library (since we are talking about music libraries) is important. This way, no external software is needed for such intelligible functions.
6) **Community.** In the era of Web 2.0, the essence of the online community for users that share common interests and opinions is often the key to the success of web applications. A specialized music library can

group the users in such a community, which (apart from its main role) will also contribute to the collection improvement and the upgrade of the offered services. The role of Web 2.0. for library resources led to new emergence for new kinds of librarianship [20]. This equals to efforts for the development of new DML services, using Web 2.0 technologies.

7) **Persistent Update.** Since a big DML has been created, the first step has been accomplished. However, the serious DMLs never stop there. There should be consistent frequent updates to: the content (new songs), the technologies (according to the evolution) and the functions (according to users' requirements).
8) **MIR.** An up-to-date DML should offer functions of Music Information Retrieval to its users. Such functions are: search, classification, comparison, pattern recognition, prediction etc. Music retrieval systems are a trend of current computer music research and a lot of systems have been proposed. These systems vary from text-based systems to more complex content-based music retrieval systems [21] [22]. MIR tasks broaden the DML's profile and enable it to be useful even for professionals: musicians and researchers.
9) **Manipulation of Large Volume of Data.** A primary issue for the implementation of a Digital Music Library is the manipulation of large volumes of differentiated data (sound, text, image, and maybe video) and metadata. The successful manipulation of them requires advanced algorithms and techniques for the following tasks: browsing, searching, abstracting, summarizing and combining data.
10) **Networked Extensions.** Successful DMLs become popular worldwide. A direct emanation of the expansion of their database is their linking with other databases. Therefore, a crucial issue is the utilization of networked databases distributed around the world.

The issues discussed above have been grouped by the authors in 5 subsections of the whole DML implementation process. The proposed framework can be seen in Figure 4.

The core aspect of a Digital Music Library is its *Music Database*, which should be enriched with content and protected by copyright laws. The *Web Presentation* of the database is associated with impressive visual representations and an easy-to-use interface. For the DML to be functional, its web presentation should offer *Services*, such as MIR functions, the notion of a music community and also autonomy. The fourth subsection deals with the networked *Extensions* of a successful DML. Finally, the *Administration* controls the other four interconnected subsections by performing persistent update of the database and the services and manipulating the large volume of data in the database.

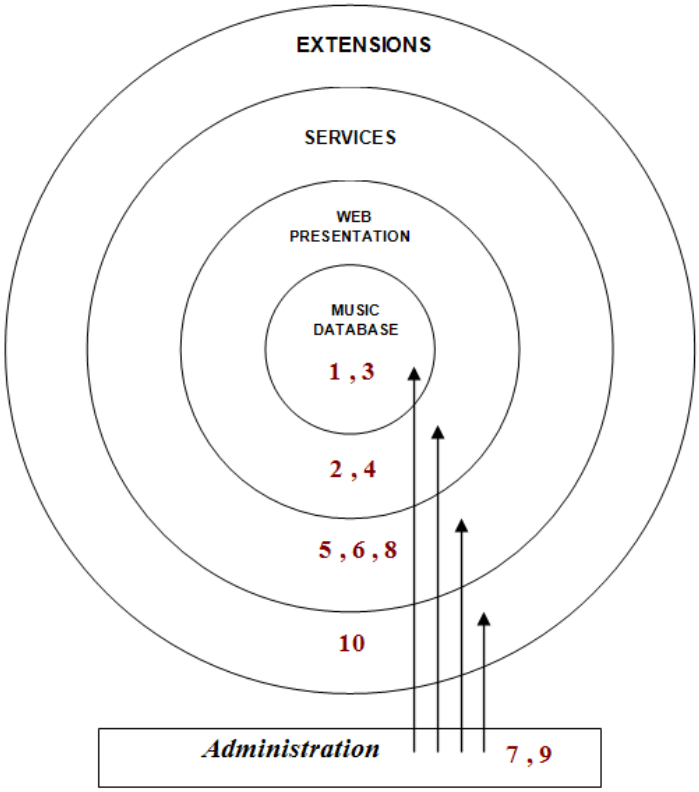

Fig. 4. Crucial issues of DMLs' implementation in a framework

4.3 XML

Standards like XML are really useful for the dissemination of information between the various architectural components of a Digital Music Library [23]. XML's origins lie in SGML, the Standard Generalized Markup Language.

Three fundamental ideas from SGML's approach to document markup were carried over into XML, which suit perfectly the concepts of a Digital Library. The first is that there are different types of documents, each constructed with its own kind of parts or elements. Thus we distinguish between a book, a letter, a report, a song, and so

forth as different sorts of documents (broadly defined). These document structures have internal hierarchies, in the sense that (for example) a book contains chapters, chapters contain paragraphs, and paragraphs contain sentences. The kind of elements that a certain type of document contains and the ways they can be organized are parts of what defines that specific type of document.

Second, the structure and segments of a document are meaningful. A title and a paragraph may both consist of a single sentence, but certain features (such as position and function) distinguish the two, and the difference is important to readers. Readers may need to locate specific elements of that sort; writers, however, may want to reorganize material in order to improve clarity or expand content. So, for example, if a computer could easily identify chapter titles and subsections, it could automatically generate a table of contents, aiding both groups. But more complex distinctions are also possible, such as the use of foreign words, and it may happen that someone will need to locate all such words. In one manner or another computer should be able to pick out these differences among element types, and perhaps display them differently as well (in the way that a title usually is presented differently from the rest of the text).

The third concept is that one can distinguish between content, the way it is presented, and the vehicle used to present it. For instance, Edgar Allen Poe's "The Tell-Tale Heart" is a text (content), which can be handwritten, printed, or spoken (presentation), and put on paper, on a computer monitor, on radio, or on tape (vehicle). In other words, the same content can be presented in different ways as needed. In addition to its inheritance from SGML, XML expands an idea from HTML: that documents should be able to link to one another. This provides the fourth fundamental concept behind XML.

5 Interaction Issues in DMLs

When the music library is created, its contents become available through a web interface, with which the user interacts. As such, there are some features that this special interface should bear. MELIRIS DML provides a representative example of an easy-to-use interface with the three basic factors of success in the interaction: search, personalization and user's satisfaction.

5.1 Searching Music

The interfaces of Internet services containing either downloadable or stream playable media almost always contain a search option. The user types into the search field a part of the name of the artist or the song preferred. When the search is conducted the search engine provides the user with some matches from the services contains, although in many cases the search results may consist of more irrational pieces of media than actual matches. These irrational results are to be referred as "noise". This noise also may lead the user to choose something irrelevant to previous search but still interesting to the user leading one to an alternative branch. From the alternative branches user can be lured by still interesting but totally irrelevant media to more and more further from the actual search issued first. In commercial services where the user needs to pay for the songs downloaded or played one might end up buying a lot of other stuff in the end not even finding the original one. Other possible scenario though is one where the search engine doesn't give any answers to the conducted search; this lack of any choices is referred as "silence". In the case of absolute silence of the search, the user needs to make another search, which can either have the reference to the piece of media preferred or again the possibility of coming up with either silence or noise. In case that the services library is built by other users as in cases of Myspace and Youtube, it could be possible to ask an other user having previously uploaded the media for example from similar genres, that if it might be possible for them to find this song using an other library, possibly their personal music library, and upload it to the service. One possible case also is to find something partly relative but not exactly the one looked for, like for example finding a live version of the song searched while the studio version would be the one preferred, on this case it is common that the user just goes with this finding unless it is very important to obtain the exactly right version, when it might be again more difficult for the user of the service. On other case, it is also possible that the song required by the user is not to be found free from any service of the Internet and the only possibility is to find it from the commercial services and pay for it or obtain it with other, more classical, methods.

The 3rd Version of the chromatic index application MELIRIS has powerful capabilities of music search. Since the application (apart from the features of a common DML) offers statistics of chromatic analysis for all the music pieces, the

search capabilities are of two kinds: *common search* (like a usual DML) and *chromatic search* (based on chromatic analysis data).

Common Search. The user may look for a particular song from the vast music collection (which appears in alphabetical order at first) by name, artist, composer or song genre. He / she can choose in which of the previous fields he is interested, or look for his/her search key in all the available fields. The results that MELIRIS returns may be sorted by any of the available fields (Fig. 5).

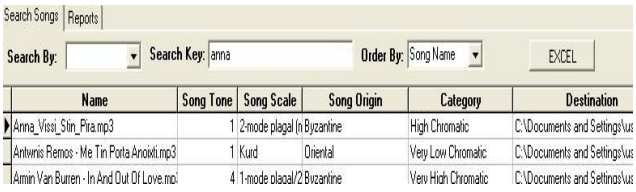

Fig. 5. Common Search in MELIRIS V.3

Chromatic Search. Apart from the common search fields (song metadata), the user may look for pieces based on musical data that are extracted from the chromatic analysis of the songs and are stored in the music library. Such data are: the chromatic category (Very Low Chromatic VLC, Low Chromatic LC, Medium Chromatic MC, High Chromatic HC, Very High Chromatic VHC) [1] , the music scale, the music tone and the song's origin. Again, the results may be sorted by any of the fields. In any case, the song's destination in the disk is returned together with the song.

Two individual reports allow the user to search for songs based on the chromatic index (similar chromaticisim means similar emotional load of melody and timbre). The first report (Top Songs by Average Chroma) looks for *the top-**n** songs where average chroma=**χ** or (**colour**) more or less by **z**% failure.* For example, Figure 4 shows the search for *the Top-3 songs where average chroma = 1.6 (or pink) more or less by 5% failure*.

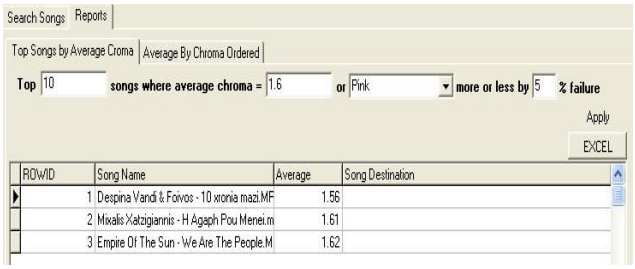

Fig. 6. Search of Top Songs by Average Chroma

The second report (Average by Chroma Ordered) allows the user to extract a music collection with songs that lie on specific chromatic boundaries. The user provides the search engine with two chromatic values and a song list with chromatic average between these boundaries is returned. In both cases, the user can extract the returned metadata in Excel format.

5.2 Personalization

Personalization is an important feature in Internet music services. The user can build a personal space of preferred links and acclaim personal preferences to personalize their user experience towards the service. This enables users to discover new songs which they are expected to like [24]. Other users can also view other users' personal pages and find out people for example with similar taste of music.

The MELIRIS application creates a personal relation with the user in 2 ways:

1. MELIRIS allows the user to differentiate the semantic way of color visualization (Figures 1 and 2), by changing the default correspondence between chromatic stages and feelings. For example, one may combine a mournful tune with white or purple, not black. The user can moderate the chromatic grades (through MELIRIS options) according to his culture, psychoacoustic perception and preferences.
2. MELIRIS makes suggestions of other users' songs, which have great chromatic similarities to the ones the user uploads. This way, the user's collection can be enriched with songs of his liking.

5.3 User's Satisfaction

Measuring satisfaction in personal towards personal preferences could be researched trough conducting a survey, and so forth be used to develop generally more satisfying applications. But generally, satisfaction means how efficiently the service works towards its purposes and how correctly the user can gain the satisfying result on using the search feature. Also, the amount of noise in search result must be highly considerate. Internet music services and DMLs should enhance ease of use and customer satisfaction in order to encourage customers to purchase music from authorised online sources and also gain their loyalty [25].

Although MELIRIS is not commercial, but the result of scientific academic research, a first questionnaire survey has been conducted to the 25 students of Computer Science Department (Aristotle University of Thessaloniki, Greece) that helped with

the creation of the Music Library and the debugging of the 3rd version. Since the particular students have used all the functions of the application, their opinion qualifies as necessary for the improvement of MELIRIS. The survey was focused on ten factors (Easy-to-use Interface, User-Friendly Interface, Search Features, Personalization Features, Covering of Music Analysis Purposes, Speed of Processes, Free of Errors, Overall Performance, Overall Quality and Overall Satisfaction), which concern MELIRIS V.3 in a Likert-5 Scale (1=Very Bad, 2=Bad, 3=Average, 4=Good, 5=Very Good). The average results are encouraging and can be seen in Figure 7.

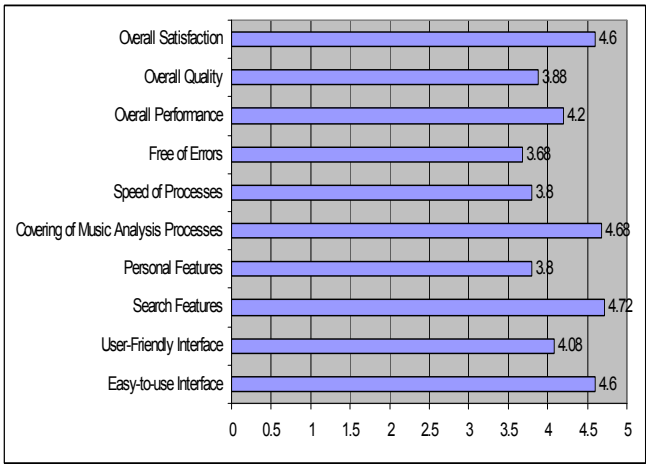

Fig. 7. Findings of survey

It is obvious from the results that the best rated function is *Search Features* (4.72), which have been previously described. Students seem to have been much satisfied with the results of their searches, as well as the way they executed their queries.

The worst rating concerns the factor *Free of Errors* (3.68), which is nevertheless satisfactory since it, is above average. This rating is due to minor bugs of the client-server 3rd version of MELIRIS, which occur occasionally during the online chromatic analysis of musical pieces. Meanwhile, much progression has already been done in the correction of those bugs. It should be noted here that the errors have nothing to do with MELIRIS as a pure Digital Music Library and its MIR system.

Finally, according to the survey, apart from the search engine of MELIRIS, its next strongest factors are: the *Covering of Music Analysis Processes* (4.68), the *Easy-to-use Interface* (4.6), and the *Overall User Satisfaction* (4.6).

6 Conclusion

The conversion from analog to digital music brought revolutionary changes to the world of discography, artists, audiences and telecommunications. The digital format of music led to the necessity of creating big music libraries in the Internet, which provide the user with great possibilities of acquiring and listening to music. Inevitably, this development created special need in the way of manipulating large volumes of music data, organizing them and providing them to music communities.

Implementation of a DML is not an easy task since it has to deal with many crucial issues concerning the building of the database, the web presentation of it, the services offered, the networked extensions and the continuous administrative work over them. But also the user-DML interaction tasks as the easy-to-use interface, the search mechanism and the personalization options affect the overall user's satisfaction, which is the key to the success of a Digital Music Library over the Internet.

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