MusicWeb,
new Communication and Information Technologies
in the Music Classroom

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Abstract:
The European project group "MusicWeb" came into existance with the objectives to take an inventory of the problems in computer-aided music education and to produce software solutions for the future years with the aid of the modern communication and information technologies. The paper presents a presentation of the system architecture as well as an initial report on the first implemented prototypes of the project.

1. Overview

Today, research centers, music libraries, conservatories, universities and the public in general wish to access the best musical information and data. Especially in the education sector this trent is emphasized by a tremendous need for flexible and open teaching systems with information retrieval abilities. The project group "MusicWeb" was formed from eight participating universities and research centers in Europe to design a system to solve these needs.

The system will encompass a central object-oriented database containing music objects (midi, sound, wave, objects with a self-made data structure), visual and text objects (text, video, pictures), and complex objects (whole applications, multimedia documents with links, complex music objects). It is planned that these objects and a user software with tools to create educational applications out of these objects will be distributed over the internet via WWW, ftp, and Corba interfaces.

The software, to be implemented by the project group and distributed to the users, will contain tools to build interactive, multimedia applications for the music classroom. Planned are author tools to create the documents, pedagogical tools to support pedagogical learning processes, interaction and communicatio tools to create a variety of different means of interaction (student-system, student-teacher, student-student), including musical interaction, and research tools to find and retrieve objects from the central database or from other archives on disc or on the net. With the completed system a teacher will be able to build for instance a training program for his students, or a student will be able to create a multimedia document with the objects taken from the archives. Completed applications will also be kept in the database to provide a user community with a library of educational applications for the use in schools, universities or private homes.

To ensure the exchange of ideas, the required feedback and the storing of finished, correct and copyrighted teaching applications a consortium with an editorial board will be formed. All institutions taking part in this consortium will have access to the database and the projects software. Communication of the consortiuum will also be handled via internet communication tools.

Research results, besides the above described system, are expected from several directions of this interdisciplinary project. New results in using object-oriented databases in connection with wide area networks and Object Request Brokers are anticipated. Design and development of an object-oriented central music data structure will be also one of the tasks, and may, with cooperation of music software vendors, be influential in setting a new music standard. Innovations in the area of open teaching and learning systems, new pedagogical theories and strategies in using modern information- and communication technologies are additional prospects of such a project as "MusicWeb".

2. The user's point of view

Objective is
- to build a system, in which software for the music classroom can be developed and accessed,
- to integrate person to person communication and on-line interactivity to educational software
- to make a growing resource of music material as well as educational software available for a public.

The system will
- enable the storing and accessing of music and multimedia objects,
- enable the building of applications out of these objects,
- provide supporting tools to build the applications out of the objects,
- enable storing and accessing of finished appplications on disc or in the database and
- provide or distribute the objects and the appllications to an international community.

In short, to be a "provider"
- for applications,

• for objects to build these applications,
• for tools to aid the building of these applications.

2.1. The client software
The user is provided with the "MusicWeb" editor, the user's interface to the whole system. It will encompass browsing as well as authoring functionality. Object browsers, as for instance the class browser in Smalltalk systems, will enable the browsing through on and off line archives or databases, showing the associational relationships between objects. Additionally a window with a graphic representation of the object linking will be included, making the applications in its link structure transparent. Seperate windows for tool sets are planned, such as link-tools, educational-tools, music-interaction-tools, communication-tools and research-tools. In order to have a stripped or stand alone application, an option of hiding everything except the application window will be implemented. To ensure that the user will always have a stable running application, he will have the possibility to copy objects onto his local net or harddisc and save his own applications locally.
With the "MusicWeb" editor
the user   can obtain whole CAT/CAL applications
• from the "MusicWeb" database,
• from CD-ROMs distributed by the project group
• or from his own set of applications on his harddisc or disc
Also with the "MusicWeb" editor the user can obtain objects from an archive to build his own applications, whereas an archive can be
• the MusicWeb Database,
• a CD-ROM collection of data (sounds, midi),
• any accessible database on the net
• or his own archives on his harddisc or disc.
The "MusicWeb" editor will offer
• browsing tools with navigational help through objects in the web
• authoring tools to create CAT/CAL applications
• search/research tools
• educational tools enabling student-computer interaction
• music tools handling music material
• communication tools enabling person to person interaction synchronously and asynchronously

2.2. The Applications
A finished CAT/CAL application created by the "MusicWeb" editor can be made up of
• a set of objects from an archive or database,
• a set of links made by a user,
• plus some additional objects such as input fields, checkboxes, guide and help texts, communication facilities
Links are stored seperately from the objects. These links are actually stored also as objects, but are not transparent as objects for the user. The seperate storing of links from the linked objects enables the user to build further applications with the same set of objects, but with new links thus adapting the application to his special needs.

3. Distribution
3.1. Products and services
Products and services of the project will include the "MusicWeb" Editor, the facility to access the objects and applications in the "MusicWeb" database, CD-ROMs and discs with collections of objects and finished applications. All members in the "MusicWeb"-Consortium will have access to these products and services.
3.2. Medium and carrier
Our medium will be the computer and a WAN/LAN (Wide Area Network, Local Area Network), the carrier will be a database on or off line, archives on discs and CD-ROMs. In the first phases of the project a normal Web Browser will function as an interface to the system, in the later phases the self-implemented "MusicWeb" editor with its authoring and browsing tools will function as the needed client software. Finished CAL/CAT (Computer Aided Learning/Teaching) applications will be made available through the internet. The musical objects themselves will be accessible through the internet, as to enable a user to build his own applications by retrieving objects from a database or any archive. Finished applications can be stored on discs, as to be distributed on off line basis.
3.3. The "MusicWeb" consortium
To ensure the exchange of ideas, the required feedback and the storing of finished and correct teaching applications

a consortium with an editorial board will be formed. All schools, universities and other institutions taking part in this consortium will have reading access to the database and the projects software. Communication of the consortium will also be handled via internet communication tools. A small membership fee should cover the costs in maintaining the database and delivering CD-ROM archives to those institutions or individuals without internet access. An editorial board of the Consortium will be responsible for the growing resource of CAT/CAL applications as well as the supervision of copyright issues.

3.4. Portability

The system itself is going to be build in a client/server architecture. In the first phases of the project, portability is ensured through the use of HTML/JAVA documents and the http protocol. Thus the finished applications will be independent of the platform they are going to run on. In the later phases an Object Request Broker (ORB) will be implemented to ensure the handling of complex musical objects and their functionality   through wide area networks.

4. System Architecture

Following is a sketch of the system. In the center is an object-oriented database management system (OODBMS) with optional other relational or object-oriented databases. On the left side of the sketch is the developers' workplace. The client software will be programmed in an object-oriented language and the programmers will access the database by local net. Data in relational databases can be manipulated and accessed through an SQL (Standard Query Language) interface. On the right side is a gateway and a dispatcher, connecting the different databases to the wide area net and organizing the retrieval. To be accesable through the net, a seperate web server is needed. Here the net community can retrieve applications and objects. In a possible third phase of the project, an interface using the CORBA standard will be added. In the first phases applications containing complex music objects might be developed on the local net, but in setting up the CORBA interface, complex objects will be available. This will enable the net community not only to retrieve html documents, but also the more complex objects, such as music pieces stored in a complex music data structure.

5. Structure of the database

5.1. Types of objects

For the user of the system three types of objects are accessable and maintained in the database. Not recognisable for the user as objects are for instance links.

- Elementary objects are made out of one entity as text files, bitmaps, wave format files, and midi files
- Complex objects consist of a number of elementary or complex objects, for instance a complex music data structure, pedagogical tools
- Applications are constructed with complex or elementary objects in addition to links between these objects. They are ready-to-use applications, such as small educational applications
- Links link the different multimedia objects together, such as a link from one text to a sound file. The links are stored seperately from the objects to obtain an optimal flexibility and adapability of the finished applications

5.2. Types of relationships in the database

There are three major types of relationships between objects which the database will have to be able to maintain. Relationships between objects concerning inheritance, containment and association are usual, in addition to self-made links maintained and manipulated in the database.
Following are examples for each kind of relationship between objects:

a. Containment ("has-a-relation")

A Mozart sonata can contain two staffs, which contain n bars, which contain n notes

b. Heritance ("is-a-relation")

The object "aMozartSonata" with its specific midifile inherits the methods (behaviour) of the class "PlayableObjectsClass"

c. Association

The object called "mozart" in the database knows about his Opus and his biography. The object "mozartOpus" knows about the sonatas. This is not an inheritance relationship, nor one of containment. It is a relationship, in

which an object knows about its related parts. These associations are responsible for the easy access and finding of objects in a database. For the user of the database, a browser showing these relations is more important than an inheritance browser, the latter being more important for the developer.

6. The interdisciplinary aspects of the project "MusicWeb"

The input work of the project can be roughly divided into several subsections, which might stand also for project groups addressing special tasks. Two main sections can be called "structuring the data" and "delivering the data", whereas the main medium to structure the data is the database. The medium to deliver the data would be the internet. Each of these sections contains a musical problem domain and computing problem domain.

Due to this interdisciplinarity of the project, a quite large variety of participants coming from commercial and academic institutions are involved actively in the consortium, ranging from universities, conservatories, schools, music software vendors, copyright institutions, network companies, music libraries to music&multimedia research centers. For more information on the project and how to join the consortium contact Carola Bšhm, music@computing, email: 100623.144@compuserve.com.

6. Bibliography

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