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# A Multilingual Web-based Educational System for Professional Musicians

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This paper presents the main results of the eContent HARMOS project. The project has developed a web-based educational system for professional musicians. The main idea of the project consists of recording master classes taught by highly recognised maestros and annotate this multimedia material using an educational musical taxonomy and automatic annotation tools. Users of the system access a multi-criteria search engine that allows them to find and play video segments according to a combination of criteria, which include instrument, teacher, composer, composition, movement and pedagogical concept. In order to preserve teachers and students rights, a DRM and protection system has been developed. The system is being publicly exploited. This model preserves musical heritage, since these valuable master classes are usually not recorded and it also provides a sustainable model for musical institutions.

**Keywords** music; taxonomy; multimedia; video; dubbing; multilingual; metadata; master class

## 1. Introduction

This paper presents the results of the European project HARMOS of the eContent Programme. One of the goals of the Harmos project is to provide access through Internet to videos of master classes from big maestros. HARMOS is defined as a collection of audiovisual contents that belong to the musical heritage where education is the principal focus and the project's main objective. The educational system has been tested by musical institutions which are partners of the project: Escuela de Música Superior Reina Sofía (Spain), Lithuanian Academy of Music and Theatre (Lithuania), Staatliche Musikhochschule Stuttgart (Germany), Royal College of Music (United Kingdom), Escola Superior de Música de Catalunya (Spain) and Escola Superior de Música and Artes do Instituto Politécnico do Porto (Portugal).

HARMOS proposes the dissemination and preservation of the teaching material from great maestros in the master classes. The reason to select this kind of teaching is that master classes are more focused than ordinary ones. The Harmos proposal does not require specific audiovisual production for contents. Master classes are usually celebrated in European conservatoires in an ordinary way. In master lessons, one exceptional professor spends two or three days with four or five students. During this time, the teacher concentrates all his/her teaching in 45 minutes or 1 hour. This concentration of knowledge does not usually happen within ordinary classes where the teachers can spend many months with more students. Due that it is not currently possible to record many months of classes, the project proposes that recording master classes is the better way to record the most useful contents.

In order to have a valuable audiovisual collection that enables its exploitation and provide a sustainable model, it is essential to check the quality of the contents to be included. The project has taken into account different criteria for selecting the contents, which include the relevance and quality of the teachers, as one of the most important criteria as well as the variety of instruments and musical styles represented on the collection (piano, violin, guitar, ancient music, jazz, etc.).

A methodology and quality assurance workflow has also been defined in order to produce high quality multimedia. This methodology defines best practices and covers the tasks of recording, digitalisation,

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compression, dubbing and analysis. The workflow requires approval and review of multimedia quality and content analysis in order to provide homogeneous criteria for the content annotation.

One of the most innovative aspects of Harnos is the analysis and annotation of recorded videos with a pedagogical musical taxonomy. During this process, musicologists identify and annotate the video segments where pedagogical instructions are being imparted, with the taxonomy presented in section 2. Since Harnos is only focused on education, only these fragments where the teacher is giving instructions are relevant for the project.

This taxonomy is used for tagging every video segment where the teacher is giving educational instructions. Video segments can be later accessed through the educational system, using three learning paths (guided search, advanced search and courses), which can be used by teachers in musical institutions or for self-study at home. These different learning scenarios have required two architectures for video serving, based on streaming or local video server. In order to provide multilingual facilities, the taxonomy has been translated to the languages of the different project partners and dubbing facilities have been incorporated.

The system includes facilities for digital rights management for teachers and students that have been recorded in the videos, which enables a sustainable business model for musical institutions. The rest of the article is organised as follows. Section 2 describes the Harnos taxonomy for annotating educational multimedia musical assets. Section 3 describes the general architecture and functionality of the system. Section 4 presents the evaluation results of the system. Finally, section 5 draws out conclusions and future works.

## 2. Harnos pedagogical taxonomy

The Harnos pedagogical taxonomy aims to cover the whole spectrum of musical practice and teaching, focusing on pedagogical aspects. The ultimate goal is to help the user to find the subjects of her interest in a few minutes or even seconds.

The potential semantic descriptors of the Harnos taxonomy are structured around three main concepts: the music, the musician and the musical expression as depicted in **¡Error! No se encuentra el origen de la referencia.**

The music branch is divided in two large subdivisions: musical technique and musical science. When both branches are overcome, the musician is able to express herself musically. In other words, to reach the art of musical expression it is necessary that one overcomes the instrument's technique and possesses a theoretical knowledge of music. Musical technique is divided into specific technique when dealing with each instrument and general technique, with general observations that are valid for any specialty.

General technique is fragmented according with four aspects: physiological and motor function aspects (hand, throat, breathing, gestures, position, etc.), aspects of the instrument's mechanics (pedal, mute, resonant bodies, care of the instrument, etc.), sound quality aspects (weight, evenness, preparing the sound, etc.), and aspects regarding the execution (fingerings, glissandi, virtuosity, etc.).

Specific technique deals with each specialty's exclusive technique. It has as many subdivisions as instrumental families (strings, winds, singing, etc.). Each of these specialties will in turn have three categories: family (woodwinds, brass, etc.), mechanics (aspects regarding material, construction, etc.) and execution (aspects regarding the type of sound emission).

An important branch of semantic descriptors will refer to music as a science where we can include such categories as: musical elements, notation, musical parameters, editions, history, organology, aesthetics, hearing, acoustics, etc. All of them concepts that make up the subjects that are treated in non-instrumental specialties and therefore are of interest to professors and students of music theory: musical forms, acoustics, aesthetics, etc.

The musician branch is subdivided into two categories: capabilities and actions. Capabilities of the musician are referring to concepts regarding the musician's aptitude and attitude towards music. The category attitude refers to the musician's attitude towards the work, regarding his studies, towards the teacher or before the public, etc. The category aptitude comprises all of the musician's capabilities and acquired, as

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well as innate, abilities that allow the development and performance of music. For example, it refers to the musician's ability regarding flexibility, physical motor coordination, interpretation abilities, memory capacity, etc.

Actions by the musician classify actions carried out by the musician to acquire scientific and technical knowledge of music, as well as to fulfil his professional aspirations. This category comprises the study methods used, how to approach studying, psychological preparation before a concert, etc. In other words, all the actions carried out regarding studying, on one side, and on the other side, regarding the musician's professional development.

The third branch, musical expression, is considered as the result of combining scientific and technical abilities with the actions the musician carries out to achieve the goal of musical expression. Considering musical expression as the goal and only reality that justifies the existence of all previous actions and abilities. Musical expression category is divided into two subcategories: elemental aspects of musical expression, such as dynamics, agogics, accentuation, articulation, etc.; and complex aspects of musical expression, from an extra-musical point of view. In other words, there are considered aspects which come from outside the boundaries of music (expressivity, character, description, etc.), as well as from a strictly musical point of view (phrasing, musical tension, etc.).

Harmos taxonomy comprises more than 400 terms for cataloguing educational musical assets, which provides a highly specialised taxonomy.

### 3. Harmos Tools

The main components of Harmos are a collaborative web-based tool for tagging and protecting multimedia contents, so called Media Management Tool, and a web-based e-learning tool so-called Virtual School.

The **Media Management Tool** comprises several components for cataloguing, protecting and exploiting digital video recorded master lessons. This tool provides functionalities for distributed cataloguing and segmentation of musical pedagogical video recordings. In order to reduce the human analysis effort, an automatic segmentation tool has been developed, which relies on the automatic description of audio content [2] This tool provides assistance to the human musical analyst providing information about potential interesting segments of the videos, which are classified in this way when the teacher is speaking. In order to protect the videos, the videos are protected with an application based on Windows Media Encoder and Windows DRM and a licence is generated per video. When the user accesses the video through the Virtual School, he/she should obtain a licence that is requested to a **Licence Server**. In addition, these access data is stored in order to carry out digital rights liquidation.

The **Virtual School** provides an end-user interface for navigating in Harmos collection and take advantage of the content cataloguing according to Harmos Musical Pedagogical Taxonomy. The Virtual School provides three learning paths:

- **Guided Search:** the user can select step by step search criteria until he/she finds the videos. The order of selections are (1) instrument, (2) teacher (and then composer) or composer, (3) composition, (4) movement and (5) video segments.
- **Advanced Search:** the user can select any combination of the criteria (instrument, teacher, student, concept, composer, composition, movement) and combine them to find a video segment.
- **Courses:** the user receives an explanation about a set of videos and some notes about the important concepts and order to see them. Courses can be created by teachers, which can select with the search tool a set of video segments, order them and add pedagogical notes.

A screenshot of the screen for reproducing a video segment and see the metadata is shown in **¡Error! No se encuentra el origen de la referencia..**

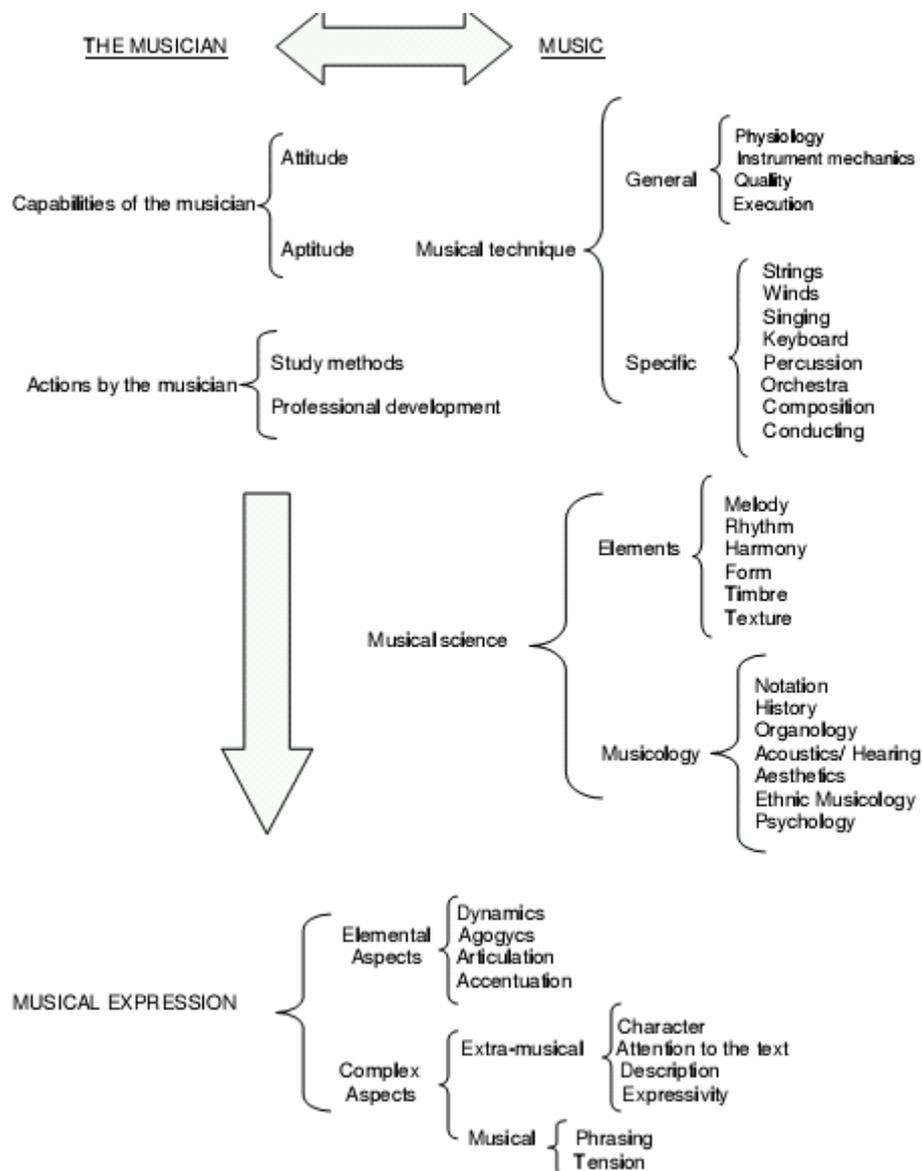


Figure 1: Harmos Taxonomy

#### 4. Evaluation

Harmos system was evaluated during the project by user experiments, from technical and user perspectives. The evaluation of the final prototype was focused to the evaluation of all the functionalities developed within the projects, as well as all the collected contents from the different institutions within the HARMOS consortium. The methodology followed was based on questionnaires and observation of users. The main results of the evaluation were that teachers and students pointed out the quality of the teachers and the metadata, and the diversity of teachers, musical instruments and styles. In addition, usability of the portal and accessibility to contents obtained very high scores. Dubbing facility was not

considered a very useful functionality. In addition, many students desired to watch longer video fragments.

The screenshot shows the Harmos web interface. At the top, there is a navigation bar with the 'Magister' logo and a search bar. Below the navigation bar, there is a breadcrumb trail: 'Master Lesson > Piano > FRANKL, Peter > CHOPIN, Fryderyk Franciszek > Sonata for piano in B minor op 10 > 1. Allegro maestoso'. The main content area is divided into two sections. On the left is a video player showing a piano performance. On the right is a 'Play list' table with the following data:

Concepts	Teachers	Composer	Duration
1 Video	FRANKL, Peter	CHOPIN, Fryderyk Franciszek	00:22:12.56
2 Contrast Character	FRANKL, Peter	CHOPIN, Fryderyk Franciszek	00:01:38.58
3 Character: 'Waltz' rigor or freedom	FRANKL, Peter	CHOPIN, Fryderyk Franciszek	00:02:22.96
4 Themes and motifs Character	FRANKL, Peter	CHOPIN, Fryderyk Franciszek	00:02:31.08

Below the table is a 'Play info' section with expandable items: Concepts (Video), Teachers (FRANKL, Peter), Composer (CHOPIN, Fryderyk Franciszek), Work (Sonata for piano in B minor op 10), and Students (Denis Kozhukhin, Tachemaher, Piann). At the bottom left, there are video controls including play, pause, stop, and volume buttons, along with a 'Select language' dropdown and a 'Original audio' checkbox.

Figure 2 Video screen

## 5. Conclusions and Future work

Harmos provide a unique tool for accessing master classes assisted by comprehensive musical metadata. The original idea of the Fundacion Albeniz of preserving teaching of current big maestros is a reality. One can imagine what it would be like to witness today the teachings of Mozart. Thanks to Harmos initiative, this cultural heritage is being preserved. The system is currently being exploited in a public web site [1] in order to provide a sustainable model for recording new material. In order to explore new ways of improving accessibility to contents, Harmos system is being extended in two research projects. The integration of web semantic technologies for defining a rich semantic ontology is being explored in the project SEMUSICI. Another perspective we are following is the exploration of a community driven approach to content enrichment and automatic enrichment with mashup web services in the European funded project VARIAZIONI of the eContentPlus programme.

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