I-MAESTRO: TECHNOLOGY-ENHANCED LEARNING FOR MUSIC

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ABSTRACT

In this paper, we present a project called i-Maestro (www.i-maestro.org) which develops interactive multimedia environments for technology enhanced music education. By exploiting new pedagogical paradigms with cooperative and interactive self-learning environments, gesture interfaces, and augmented instruments, this project builds on recent innovations resulting from the development of computer and information technologies and explores novel solutions for music training in both theory and performance. This paper discusses general context of the project along with the developments, together with an overview of the framework and highlights a number of different tools to support technology-enhanced music learning and teaching.

1. INTRODUCTION

The i-Maestro project explores innovative solutions for technology-enhanced music education with a particular focus on bowed string instruments.

Music performance is not simply to play the right note at the right time. Among the many challenging aspects of music education, we are particularly interested in linking music practice and theory training, looking at interactivity, expressivity and accessibility.

Guided by an analysis of pedagogical needs, the project develops enabling technologies to support music performance and theory training, including tools based on augmented instruments, gesture analysis, audio analysis and processing, score following, symbolic music representation, cooperative support and exercise generation for tuition, self-learning, and collaborative work scenarios.

i-Maestro offers a flexible, interactive multimedia framework and supporting tools which builds on recent innovations resulting from the development of computer and information technologies.

2. FRAMEWORK AND TOOLS

With the continuous user requirements analysis, a set of use cases, test cases and pedagogical scenarios have been translated into specifications of the framework and tools. An overview of the framework is given in the diagram as presented in Figure 1.

In this section, we highlight several i-Maestro tools that support different aspects of music learning and teaching.

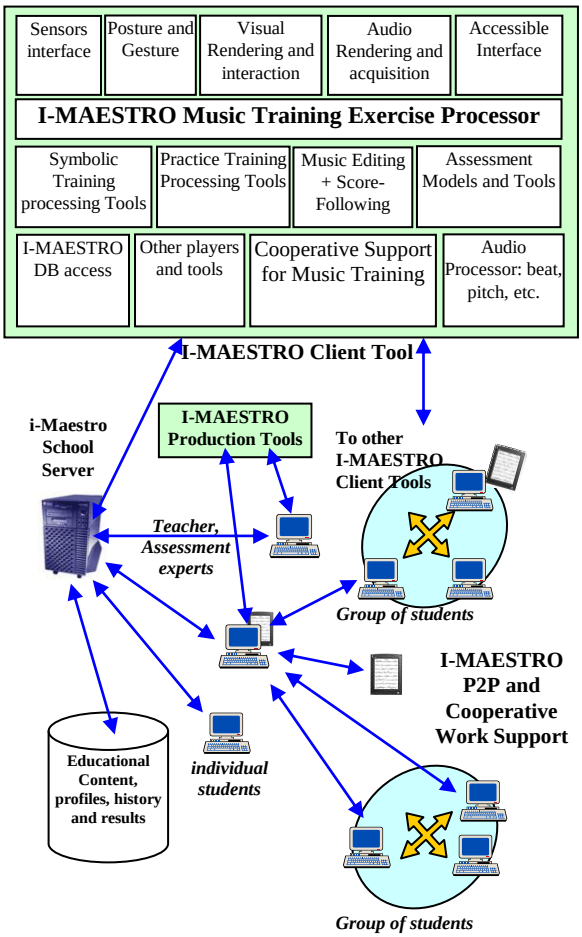

Figure 1. An overview of the i-Maestro framework.

2.1. Symbolic Music Representation

Music notation is fundamentals in music education. i-Maestro is promoting MPEG Symbolic Music Representation (SMR), an ISO standard for the representation of music notation with enhanced multimedia features [3, 4, 8, 9, 15].

Figure 2 shows an MPEG SMR player/decoder, which has been implemented within the IM1 MPEG-4 reference software.

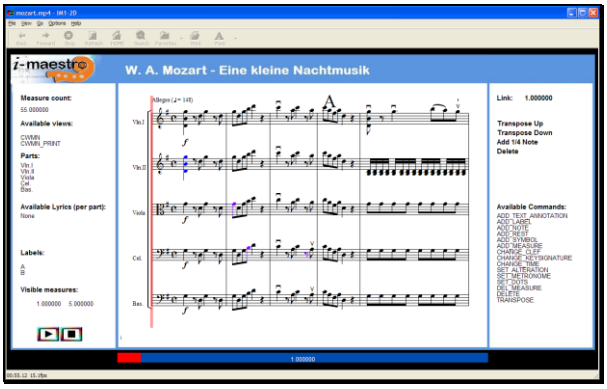

Figure 2. An MPEG SMR player/decoder.

2.2. Cooperative Environment, Exercise Generator and the School Server

Cooperative work is another key area of music education. It allows different components of the i-Maestro framework to be used across a network. Figure 3 shows an example student view of a collaborative ear training exercise.

Figure 3. Cooperative interface for ear training.

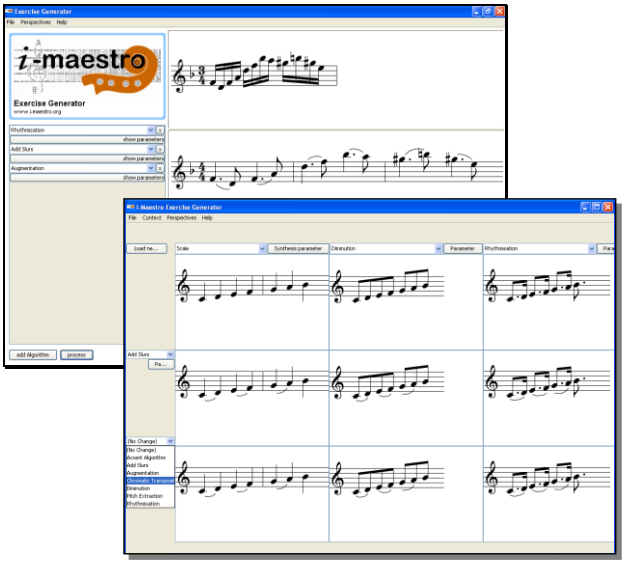

Figure 4.Screenshots of the i-Maestro Exercise Generator.

Figure 5. i-Maestro School Server interface.

Other tools include the Exercise Generator, which supports (semi-)automated creation of exercises (see Figure 4) and the School Server (see Figure 5) offers online access to stored lesson material for sharing learning material at home and in the classroom.

2.3. Music Training Supports

The i-Maestro Sound and Gesture Lab includes advanced audio analysis, gesture- and score- following algorithms that provide feedback and accompaniment allowing new kinds of musical interaction (see Figure 6, left). The Gesture Follower can track a performed gesture in real time and compare it with pre-recorded gestures for a variety of pedagogical applications. The Augmented Violin allows bowing gestures to be tracked and studied (see Figure 6, right).

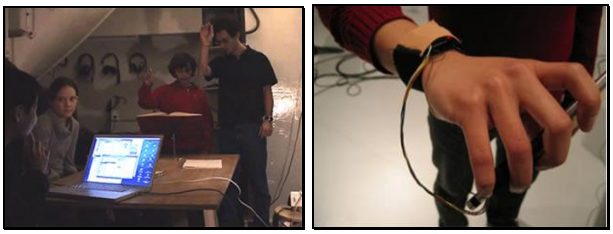

Figure 6. The Score Follower listens to the player and provides automated “page turning” and accompaniment.

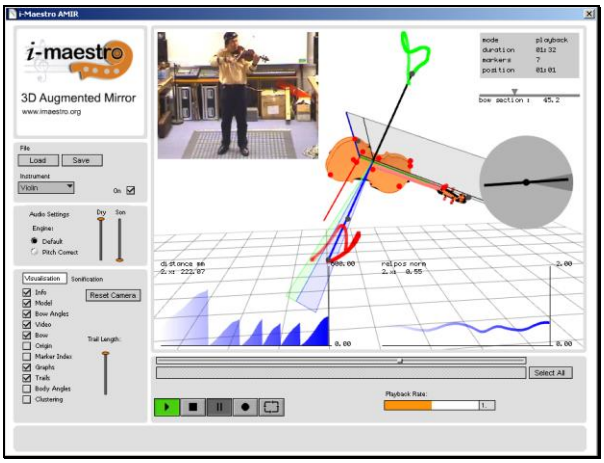

Figure 7. AMIR for 3D visualisation and sonification of a bowing exercise.

The i-Maestro 3D Augmented Mirror (AMIR) [11, 13, 14, 17, 18] captures and visualises the performance in 3D (see Figure 7). It offers a number of different analyses to support the teaching and learning of bowing technique and body posture. The tool provides interactive multimodal feedback, online and offline with visualisation and sonification [19].

2.4. Integration

The combination of tools leads to new functionality, e.g. the automatic annotation of a score with bowing symbols in real time while a musician is playing, which is reached by combining, score follower, motion capture and SMR support. An application (called the i-Maestro Start) has been created to offer students and teachers a unique tool to start all the tools offered by i-Maestro. With the tools now available, validation is being carried out with teachers in music schools and conservatories.

3. CONCLUSION

The project continued its work on pedagogical aspects, enabling technologies, software components, integrations and validation activities. An overarching pedagogical approach and model [16] for technology-enhanced teaching and learning has been developed. On this basis, a set of detailed pedagogical scenarios related to the use of the i-Maestro tools has been created.

This paper presented a brief overview of the i-Maestro project. With the introduction, the paper presented the overall framework design and introduced several tools to support music learning and teaching including MPEG SMR for theory training, gesture analysis for performance training, with a particular focus on the 3D gesture and posture support using the 3D Augmented Mirror.

The final results consist of a framework for technology-enhanced music training, that combines proven and novel pedagogical models with technological tools such as collaborative work support, symbolic music processing, audio processing, and gesture interfaces. Offering accessible tools for music performance and theory training will ensure wide participation.

Prototype tools are now available and are expected to be incorporated in various new products and services, which will be made available to both the general public and educational establishments. These are being validated and refined and the project is inviting music teachers and students to take part in the validation phase. We are particularly interested in testing the system in real pedagogical situations to see how teachers and students interact with the technology. At the ICSRiM - University of Leeds (UK), open lab sessions are being organised for people to come and try out the i-Maestro 3D augmented mirror system with a 12-camera motion capture system.

4. ACKNOWLEDGMENTS

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