i-Maestro Framework and Interactive Multimedia Tools for Technology-Enhanced Learning and Teaching for Music

Kia Ng[1] and Paolo Nesi[2]
[1] *ICSRiM – University of Leeds,*
School of Computing and School of Music, Leeds LS2 9JT, UK
[2] *DISIT-DSI – University of Florence*
Via S. Marta 3, 50139 Firenze, Italy

info@i-maestro.org *www.i-maestro.org*

Abstract

The i-Maestro project (www.i-maestro.org) has been supported by the EC IST 6th Framework Programme to develop interactive multimedia environments for technology enhanced music education. Building on recent innovations resulting from the development of computer and information technologies, the project explores novel solutions for music training in both theory and performance, and exploits new pedagogical paradigms with cooperative and interactive self-learning environments, gesture interfaces, and augmented instruments. This paper presents a brief overview of the project, together with some highlights of selected tools.

1. Introduction

The i-Maestro project [1, 12, 18, 19] aims to explore novel solutions for music training in both theory and performance with particular focus in string instruments.

With an analysis of pedagogical needs, the project develop 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. The resulting i-Maestro framework for technology-enhanced music learning is designed to support the creation of flexible and personalisable exercises and lessons, and aims to offer pedagogic solutions and tools to maximise efficiency, motivation, and interests in the learning processes and improve accessibility to musical knowledge.

A process of continuous user requirements analysis was started since the beginning of the project which forms the basis of the specification of a framework which include enabling technologies, pedagogic tools and the production of content, and supportive pedagogical aspects, such as modelling and formalising educational models for music, courseware production tools. These include innovative aspects, such as models and support for cooperative training, interactive and creative interfaces with sensors, and gesture tracking, client tools for theory and play training, distribution and management tools for music lessons, and music exercise generation.

The outcomes are being validated by several European institutions including Accademia Nazionale di Santa Cecilia (Rome), the Fundación Albéniz (Madrid) and IRCAM (Paris).

2. Framework and Tools

The user requirements and a set of pedagogical scenarios with use cases and test cases have been translated into specifications of the framework and tools (see Figure 1).

All the tools, e.g. the notation editor and player [3, 4, 8], score-follower [6, 7, 10], gesture support [13, 14], and exercise generator, have been designed and developed. Validation activities have been started with teachers in music schools and conservatories to test and enhance the tools in specific pedagogical practice.

The following subsections highlight several selected tools.

978-0-7695-3406-0/08 $25.00 © 2008 IEEE
DOI 10.1109/AXMEDIS.2008.41

2.1. Music Training Supports

Sensor interface and several pedagogical contexts have also been developed to support students to internalise key musical concepts with the interactive tools. Figure 2 shows the wireless module and sensor setup to provide various analysis and feedback of the playing (augmented violin [7])

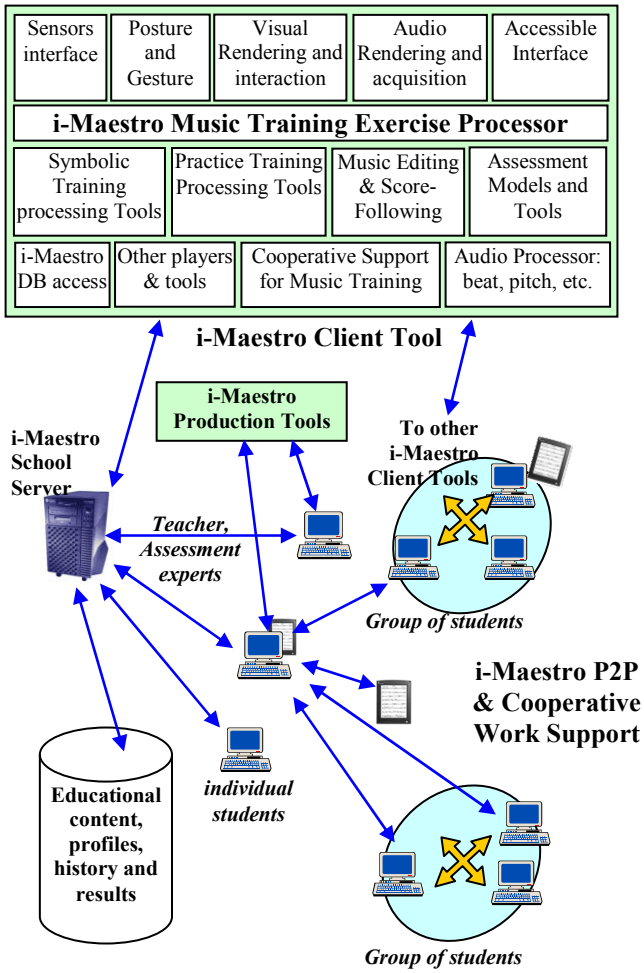

Figure 1. An overview of the architecture.

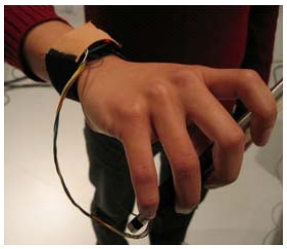

Figure 2. Wireless module and sensor.

3D motion capture technology is also being ultilised. Figure 3 shows the 3D Augmented Mirror (AMIR) [11, 13, 14, 17, 18] captures and visualises the performance in 3D. It offers a number of different analyses to support the teaching and learning of bowing technique and body posture.

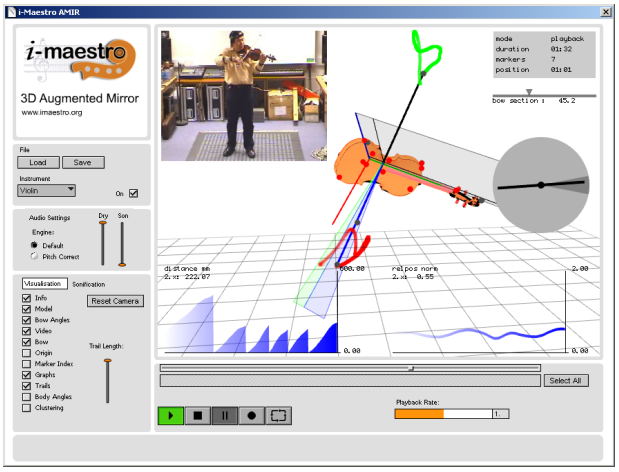

Figure 3. AMIR for 3D visualisation and sonification of a bowing exercise.

2.2. Symbolic Music Representation

Music notation is one of the 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].

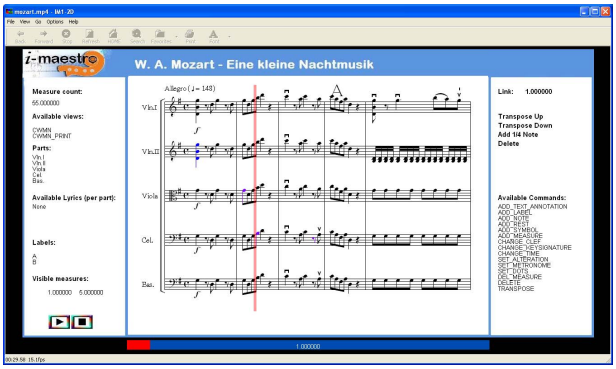

Figure 4. An MPEG SMR player/decoder.

2.3. Multimodal Representation and More Tools

An adaptation of the SDIF format has been developed to represent sensor, motion, and analysis data, raising interest from practitioners of the domain.

Cooperative work is another key area of music education. It allows different components of the i-Maestro framework to be used across a network.

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

2.4. Integration

The individual tools are brought together for integration, linking them into the overall framework. 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.

3. Reflections and Future Directions

The project has worked on pedagogical aspects, enabling technologies, i-Maestro software components, and started validation activities. In addition, guidelines for accessibility in technology-enhanced music training have been developed [2, 5].

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.

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 as well as for authoring lessons and exercises will ensure wide participation.

Many prototype tools available will be incorporated in various new products and services, and will be made available to both the general public and educational establishments. These are in the process of being validated and refined and the project is inviting music teachers and students to take part in the testing phase the i-Maestro software.

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

The research is supported in part by the European Commission under Contract IST-026883 I-MAESTRO. The authors would like to acknowledge the EC IST FP6 for the partial funding of the I-MAESTRO project (www.i-maestro.org), and to express gratitude to all I-MAESTRO project partners and participants, for their interests, contributions and collaborations.

5. References

[1] i-Maestro project website: www.i-maestro.org

[2] i-Maestro project Deliverable DE4.5.1 on Accessibility aspects in Music Tuition, available online via http://www.i-maestro.org/documenti/view_documenti.php?doc_id=629

[3] P. Bellini, P. Nesi, G. Zoia. MPEG Symbolic Music Representation: A Solution for Multimedia Music Applications. Published on Interactive Multimedia Music Technologies, Copyright © 2008 by IGI Global. ISBN 978-1-59904-150-6 (hardcover) - ISBN 978-1-59904-152-0 (ebook).

[4] P. Bellini. XML Music Notation Modelling for Multimedia: MPEG-SMR. Published on Interactive Multimedia Music Technologies, Copyright © 2008 by IGI Global. ISBN 978-1-59904-150-6 (hardcover) - ISBN 978-1-59904-152-0 (ebook).

[5] Neil Mckenzie and David Crombie, Creating Accessible Interfaces for i-Maestro Learning Objects, in Proceedings of the Second International Conference on Automated Production of Cross Media Content for Multi-channel Distribution (AXMEDIS 2006), www.axmedis.org/axmedis2006, Volume for Workshops, Tutorials, Applications and Industrial, pp. 87-91, 13th – 15th December 2006, Leeds, UK, Firenze University Press (FUP), ISBN: 88-8453-526-3, http://digital.casalini.it/8884535255

[6] Cont, A., Schwarz, D. (2006), Score Following at IRCAM, MIREX'06 (Music Information Retrival Evaluation eXchange), The Second Annual Music Information Retrieval Evaluation eXchange Abstract Collection, Edited by The International Music Information Retrieval Systems Evaluation Laboratory (IMIRSEL), Graduate School of Library and Information Science, University of Illinois at Urbana-Champaign http://www.music-ir.org/evaluation/MIREX/2006_abstracts/MIREX2006Abstracts.pdf, p. 94, October 2006, Victoria, Canada (http://ismir2006.ismir.net/)

[7] F. Bevilacqua, N. Rasamimanana, E. Fléty, S. Lemouton, F. Baschet (2006) The augmented violin project: research, composition and performance report, 6th International Conference on New Interfaces for Musical Expression (NIME 06), Paris, 2006

[8] Pierfrancesco Bellini, Paolo Nesi, Maurizio Campanai, Giorgio Zoia, FCD version of the symbolic music representation standard. FCD version of the symbolic music representation standard, MPEG2006/N8632, October 2006, Hangzhou, China

[9] P. Bellini, F. Frosini, G. Liguori, N. Mitolo, and P. Nesi, MPEG-Symbolic Music Representation Editor and Viewer for Max/MSP, in Proceedings of the Second International Conference on Automated Production of Cross Media Content for Multi-channel Distribution (AXMEDIS 2006), www.axmedis.org/axmedis2006, Volume for Workshops, Tutorials, Applications and Industrial, pp. 87-91, 13th – 15th December 2006, Leeds, UK, Firenze University Press (FUP), ISBN: 88-8453-526-3, http://digital.casalini.it/8884535255

[10] Norbert Schnell, Frederic Bevilacqua, Diemo Schwarz, Nicolas Rasamimanana, and Fabrice Guedy, Technology and Paradigms to Support the Learning of Music Performance, in Proceedings of the Second International Conference on Automated Production of Cross Media Content for Multi-channel Distribution (AXMEDIS 2006), www.axmedis.org/axmedis2006, Volume for Workshops, Tutorials, Applications and Industrial, pp. 87-91, 13th – 15th December 2006, Leeds, UK, Firenze University Press (FUP), ISBN: 88-8453-526-3, http://digital.casalini.it/8884535255

[11] Ong, B., Khan, A., Ng, K., Nesi, P., Mitolo, N. (2006), Gesture-based Support for Technology-Enhanced String Instrument Playing and Learning. International Computer Music Conference (ICMC) 6-11 November 2006, New Orleans, Louisiana, USA, ISBN: 0-9713192-4-3

[12] Bee Ong, Kia Ng, Nicola Mitolo, and Paolo Nesi, i-Maestro: Interactive Multimedia Environments for Music Education, in Proceedings of the Second International Conference on Automated Production of Cross Media Content for Multi-channel Distribution (AXMEDIS 2006), www.axmedis.org/axmedis2006, Volume for Workshops, Tutorials, Applications and Industrial, pp. 87-91, 13th – 15th December 2006, Leeds, UK, Firenze University Press (FUP), ISBN: 88-8453-526-3, http://digital.casalini.it/8884535255

[13] Kia Ng, Oliver Larkin, Thijs Koerselman, and Bee Ong, i-Maestro Gesture and Posture Support: 3D Motion Data Visualisation for Music Learning And Playing, in Proceedings of EVA 2007 London International Conference, Eds: Jonathan P. Bowen, Suzanne Keene, Lindsay MacDonald, London College of Communication, University of the Arts London, UK, 11-13 July 2007, pp20.1-20.8.

[14] Kia Ng, Oliver Larkin, Thijs Koerselman, Bee Ong, Diemo Schwarz, Frederic Bevilacqua, The 3D Augmented Mirror: Motion Analysis for String Practice Training, p. 53-56, in Proceedings of the International Computer Music Conference, ICMC 2007 – Immersed Music, Volume II, pp. 53-56, 27-31 August 2007, Copenhagen, Denmark, ISBN: 0-9713192-5-1

[15] Kia Ng and Paolo Nesi (eds), Interactive Multimedia Music Technologies , ISBN: 978-1-59904-150-6 (hardcover) 978-1-59904-152-0 (ebook), 394 pages, IGI Global, Information Science Reference, Library of Congress 2007023452, 2008.

[16] Tillman Weyde, Kia Ng, Kerstin Neubarth, Oliver Larkin, Thijs Koerselman, and Bee Ong, A Systemic Approach to Music Performance Learning with Multimodal Technology
Support, in Theo Bastiaens and Saul Carliner (eds.), Proceedings of E-Learn 2007, World Conference on E-Learning in Corporate, Government, Healthcare, & Higher Education, Québec City, Québec, Canada, Association for the Advancement of Computing in Education (AACE), October 15-19, 2007.

[17] Thijs Koerselman, Oliver Larkin, and Kia Ng, The MAV Framework: Working with 3D Motion Data in Max MSP / Jitter, in Proceedings of the 3rd International Conference on Automated Production of Cross Media Content for Multi-channel Distribution (AXMEDIS 2007). Volume for Workshops, Tutorials, Applications and Industrial,
i-Maestro 3rd Workshop, Barcelona, Spain, ISBN: 978-88-8453-677-8, 28-30 November 2007.

[18] Kia Ng, Tillman Weyde, Oliver Larkin, Kerstin Neubarth, Thijs Koerselman, and Bee Ong, 3D Augmented Mirror: A Multimodal Interface for String Instrument Learning and Teaching with Gesture Support, in Proceedings of the 9th international conference on Multimodal interfaces, Nagoya, Japan, pp. 339-345, ISBN: 978-1-59593-817-6, ACM, SIGCHI, DOI: http://doi.acm.org/10.1145/1322192.1322252, 2007

[19] Kia Ng, 4th i-Maestro Workshop on Technology-Enhanced Music Education, in Proceedings of the 8th International Conference on New Interfaces for Musical Expression (NIME 2008), Genova, Italy, 5-7 June 2008.