INCORPORATING ACCESSIBILITY WITHIN PEDAGOGICAL ENVIRONMENTS

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Abstract: The I-Maestro project seeks to undertake research and a development in the field of Technology enhanced education within music. The authors as part of the project consortium are responsible for the accessibility aspects which come along with this; namely providing functionality to support accessible music formats such as Braille Music, Talking Music and large print music and also helping the consortium to create user interfaces which are both accessible and usable. This paper will present the latest work in this area, and demonstrate an implementation of integrating accessibility and adaptive technologies with cutting edge initiatives for Music education and pedagogy in general. The paper will present a first prototype of the learning environments being created for the project.

Keywords: Accessibility, Music, Pedagogy, eLearning

1. Introduction

Accessible solutions are required for anyone who requires assistance in using the mainstream solution. This could be because a user is dyslexic, blind, visually impaired, or impaired in some other way, but increasingly this is age-related. Accessible solutions can range from small assisted applications (such as a screen magnifier), to full-scale operating systems and screen reading environments. The traditional problem with accessible solutions is that they are normally implemented as an afterthought or piggy-back solution. This results in solutions which are not fully integrated (or not well integrated) with the mainstream solutions. These independent applications are then at a disadvantage when software versions or operating systems are updated. In order to make this integration process easier, and provide more intuitive designs for the future, it is essential that "Design for All" and accessible design methodologies are widespread. Standard, policy and legislation also helps ensure that accessible designers have a solid standard to meet to ensure future-proofing.

There has been a decline in the teaching of Braille music to visually impaired children in recent years. In order to rejuvenate interest in Braille music, better pedagogical models must be utilised which incorporate Braille music into part of the musical curriculum in countries across Europe. One of the essential components in achieving this is that Braille music production methods must be integrated with current pedagogical technology to ensure that Braille music representations are always close to hand in the same environment as mainstream representations. In order to rejuvenate the teaching of music in accessible formats, a pedagogical model has to be adopted which injects life into the dwindling communities of teachers, users, and students who use music in alternative formats.

2. I-Maestro

The I-Maestro project (WWW1, undated) will utilise and improve upon current standards related to music education. The project aims to explore a unified educational model to maximise efficiency, motivation and interests in the learning processes and to contribute to:

- the deployment and improvement of ISO MPEG-SMR (Symbolic Music Representation) to support music education,
- the implementation of music notation/representation into MPEG-4,
- the production of guidelines on how the music tuition courseware can be implemented in standard tools and models for distance learning.

The main technical objectives of the project include: basic research and development on new solutions and enabling technologies to support traditional pedagogical paradigms for music training; novel pedagogical paradigms, such as cooperative-working, self-learning and class-studying, with particular focus on Symbolic Training paradigms and Practice Training paradigms for string instruments exploring interactive, gesture-based, and creative tools; and a framework for technology-enhanced music educational models and tools to support the creation of flexible and personalisable e-learning courses to improve accessibility to the musical knowledge.

The outcomes will be validated through a set of tools and methodologies including:

- tools and methods for music courseware production;
- interactive and creative tools for instrumental training in different environments such classrooms and cooperative work, on different devices such as PC and Tablet-PC; and
- assessment and pedagogical models for music training.

2.1 Accessibility within I-Maestro

DEDICON became involved in the I-Maestro project following their work in Wedelmusic (WWW2, undated) and the Music Network (WWW3, undated). During this time, and following research into accessible music formats, the organisation created a suite of plugins for the Finale Music Notation software (Crombie et al., 2002, 2004) which allowed the creation of Braille Music and Talking Music automatically. This was the basis for joining the I-Maestro consortium: to take this work and the theory behind this work further.

Work has been carried out on a state of the art analysis of the user requirements, file formats, standards and technologies for accessible music tuition such that the field of accessible music learning can be established to an extent that analysis of the accessibility issues and their impact on music education for regular learners and those with special needs can be made for the I-Maestro project. The assistive technologies relating to accessible music and accessibility in general (Sonification, screen readers, gesture and posture analysis, alternative representation and devices, zooming, spoken music, etc.) have been overviewed in an extensive document such that the technology is available for incorporation into technologies developed in the other work packages of I-Maestro. This report is available from the I-Maestro web site (WWW4, undated)

The project aims to create author ware for lesson packages; this requires consideration of many aspects of accessibility relating to the content, the software and the music excerpts used. This paper overviews what is required to create environments offering solutions for Accessible Music Education, and what tools are available to assist in the creation of these environments.

There are three groups of accessibility choices for learners defined within AccessForAll:

1. Display (how the user interface and content should be presented)
2. Control (alternative ways of controlling a device)
3. Content (specification of auxiliary, alternative or equivalent content requirements).

From the state of the art information, specific difficulties in learning music from the user perspective can be detected, in order that these modalities can be incorporated within I-Maestro technologies, and this can feed back into the I-Maestro project. This allows the specification of user requirements and extensible systems, which are outlined within existing I-Maestro research to link to the models used for learning, such that the technologies can be tuned to meet the correct mechanisms suited to the user needs.

Based on this analysis, an accessibility evaluation framework has been constructed for I-Maestro. The guidelines for this framework (based on WAI standards (WWW5, WWW6, undated)) are available as reference material to the consortium in order that accessibility aspects can be considered during the design of I-Maestro technologies. Using this framework, the technologies created during the development stages of the project will be assessed and then improved in terms of accessibility based on both technologies created by I-Maestro or assistive technologies native to the operating system being used. It is expected that after initial evaluation there will be several key problems which will need to be tackled to create accessible learning tools. These stem from the innovative nature of many of the technologies being created by the consortium.

3. The I-Maestro Software

The I-Maestro project will produce several pieces of software, many of which will require the facility to edit musical notation. This will involve varying degrees of complexity, from a single student completing a simple theory exercise to a group editing multiple parts on a score collaboratively. A music editor module is being developed for this purpose by the University of Florence's Dipartimento di Sistemi e Informatica (DSI) (WWW7, undated). This editor will be based around the new MPEG-SMR (Symbolic Music Representation) format.

Dedicon are responsible for modifying this notation editor to be accessible to users of various alternative musical notation formats, such as Braille music, spoken music, and large print music.

3.1 The SMR format

Several currently available formats allow some sort of integration of musical notation with a multimedia representation of the music. SMR is an attempt to integrate musical notation into the widely used Moving Picture Experts Group MPEG4 standard. This will bring a large range of benefits and opportunities. Interoperability between systems dealing with music will be increased by use of a common format. The new format will bring new opportunities for education, and in particular for the delivery of educational material (Bellin et al, 2006).

The MPEG format provides profiling, to allow only a subset of the available features to be supported by any given application. This allows for scalability, and will mean that small devices such as mobile phones will be able to use SMR without having to support the whole MPEG4 format, further increasing the opportunities provided by this format (WWW8, undated).

3.2 Accessibility extensions

By storing the underlying music notation in a logically structured format like SMR, it will be possible to represent the music in different formats, depending on each user's requirements. This will allow alternative, accessible interfaces to be created for users of Braille Music, Talking Music, and Large Print Music.

In order to create authoring tools for accessible eLearning, the I-Maestro software packages will need means of Inputting, Outputting and Interacting with these three accessible formats. In order to do this, basic input/output components will be needed for MAX/MSP, the graphical programming environment chosen for producing all I-Maestro software.

The input for all three accessible editing interfaces will come directly from DSI's SMR editor. To ensure that changes made to the score by other students through the collaborative editing system can

be used to update the accessible representation of the score, these changes will have to be forwarded to the accessible I/O module in real time. This will also mean that the graphical and alternative representations on the visually impaired student's computer will be synchronized, helping sighted teachers and pupils to offer assistance. Similarly, changes made to the accessible representation will be sent back to DSI's SMR editor in real time, so that in the case of collaborative editing, other students will see the changes immediately on their own computers.
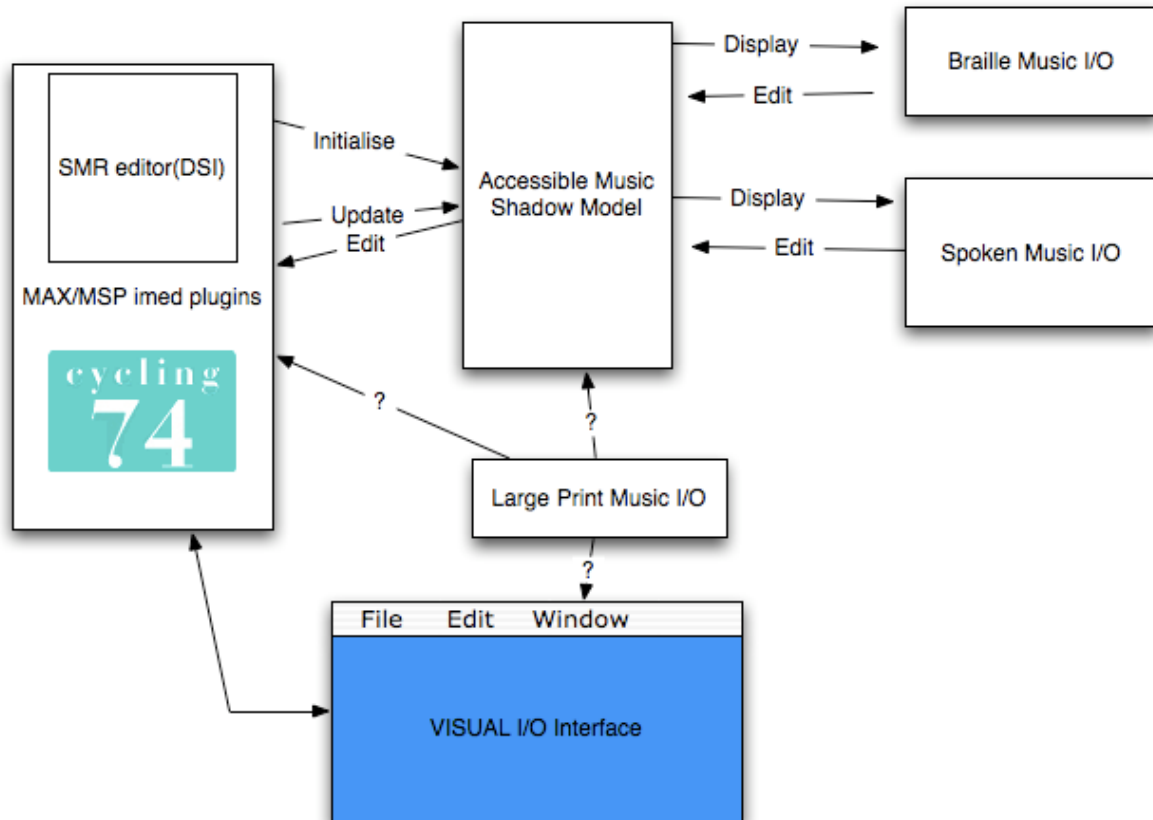
By way of illustration, a diagram is provided below:

Figure 1: Diagram of the Accessibility components of I-Maestro

The above diagram displays the SMR editor on the left. The SMR editor is a music editor which was produced as MPEG reference software as part of the standardisation procedure within MPEG. For the purposes of I-Maestro it has been provided with a MAX/MSP wrapper called the "imed plug-in" which allow various modules running under the MAX/MSP runtime environment to access functionality and information within the SMR editor.

Dedicon's task was to provide accessible music format extensions to this work. In order to do this, a similar architecture to that employed in the Finale Plugins project has been used. A much simpler model of the music is created, called the "accessible music shadow model." From this "shadow model," accessible representations such as Braille Music and Spoken Music can be created. One advantage of this architecture is that with an appropriate wrapper to load the "shadow model" from another source, it becomes easy to reuse the accessible editing interfaces with other music editors.

The first aim of the Accessible Music extensions is to display I-Maestro lessons in the form of Braille Music and Spoken Music. Once this is successful, it is hoped that two way feedback between the various modules can take place, allowing Braille and Spoken representations to be edited and the changes fed back into I-Maestro music lessons.

Large Print Music is dealt with in a different way, as it can use much of the same code which is used to render standard music notation on the screen. An analysis of these rendering modules is yet to

take place. Once this is done, the decision can be made as to whether the data needs to be pre-processed through the shadow model.

3.3 Accessible interfaces

Representing accessible music notations within the I-Maestro framework is one level of accessibility, but it would also be advantageous if impaired end users can interact with the software. In order that the I-MAESTRO client tool is accessible software, several design considerations have to be taken into account in the system architecture to ensure that standard accessibility controls and components are included within at least the modules used for Accessibility. The system should take into account the use of:

- Textual alternative descriptions of any icons, images, access buttons, text field labels, menu item and other components used for accessing functionality within the I-MAESTRO client tool
- Alternative means to access functionality other than with a mouse i.e. ensure that all actions can be completed from the keyboard.
- The standard components available for the operating system or development platform, or follow accessibility guidelines on how to create custom controls.
- Provide help files, including an orientation to the interface and its functionality.

The following should be avoided:
- Indexing or navigation systems using complex frames that do not have the title or name attribute.
- Tables of contents with expand/collapse features that are indicated with images with no text labels (i.e., blue triangles or plus and minus signs).
- Menu bars built in non standard scripting languages.

In order to meet these requirements fully, it may be required to create several interface specific modules within MAX/MSP which can provide some of these functionalities. Ideally these functionalities can be "silent" in that they are available to users depending on the user profile. This will be outlined in documentation which the teacher can use to personalise lessons for end users.

4. Conclusions

The I-Maestro project represents an innovative research project into the area of Technology enhanced music education. As such it is important that accessibility is included in these developments, such that the solutions in this area which emerge in the future have accessibility considered from the start. Accessible Music formats are falling into disuse as they are seldom included in technology which is becoming standard in the field of music. As a result, it is hoped that I-Maestro can contribute to the continuing use of these formats.

The choice of MAX/MSP as an authoring tool framework is a challenging one for accessibility as its openness of design represents quite a challenge in creating accessible interfaces. The research challenge is however useful as I-Maestro is one of the few projects which is looking at usability and accessibility in a framework which previously was primarily used by music technologists and computer music composers with little concern for the user requirements of people outwith that immediate field.

The work is continuing and anyone with an interest in its progress should check www.imaestro.org for updates, or contact the authors of this paper. We would especially be interested in anyone who would be interested in user testing the beta software as it develops.

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