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A Virtual Orchestra Game for Introducing Children to Music

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Overview

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The Idea

- Usually music students don't have opportunities to practice conducting with an orchestra (often they practice by conducting a pianist!)



- Can we help them somehow?



Project Aims

- Providing a basic tool for students to practice the most fundamental conducting patterns
- Making a game that can be fun while introducing young children to music making (and to understand what that crazy guy waving his arms on stage is doing!)

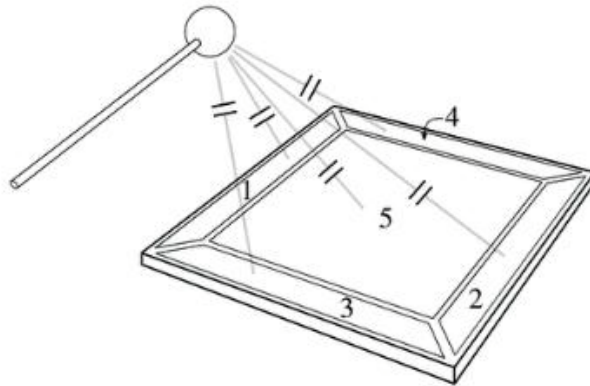




Virtual Orchestras

Max Mathews Radio Baton

- The Radio-Baton is a device which tracks the motions of the tips of 2 batons in a 3 dimensional space.



Integrated with the Director Musices software - KTH Stockholm (Prof. Johan Sundberg) and used in several live performances.






“Virtual Conductor”: permanent exhibit at the House of Music in Wien, features a set of pre-recorded movies and pre-processed audio tracks (Prof. Jan Borchers).

Improved versions are showcased in Children’s Museums in Milwaukee and Boston



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Our perspective

- Making an interactive experience featuring both real time music synthesis and video animations
- Go beyond tempo/dynamics changes (what about adding articulation?)
- Bad conducting? Bad performance!





But... is it *really* a game?

- Assuming we can control virtual musicians by our movements, how do we turn it into a game and how can we make the whole experience “fun” and entertaining for a kid?



- Unexpected graphics
- Competition
- Challenge
- Multimedia Feedback



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An unconventional stage





Competition

- Players must be able to compare their results and see who is the best “Maestro”
- Accomplished by designing a score system that tries to evaluate the performance like a possible audience would do.





Challenge

- Pleasing the 'virtual' audience can be more and more challenging according to an overall difficulty level which can be set before the performance starts



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Audio feedback

- Virtual musicians should play badly if the player conducts poorly
- Audience feedback: different applauses at the end of the performance. Should jeering and booing be allowed?



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Video feedback

- Each orchestra section has a “concentration level” which decreases when they make mistakes, lowering the player’s score





Video feedback

- Eye candy:
 - falling stars as visual reward when the player is doing a good job
 - If the performance is too slow or too fast, appropriate icons show up
 - If the player is doing several good gestures in a row, show “combo”-like icon





How the game works

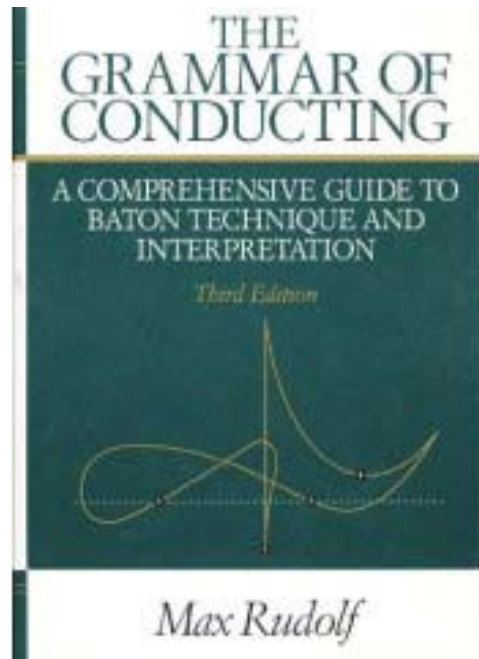
- Training mode
- Concert mode





Training Mode

- To explain the basic conducting gesture, taken from Max Rudolf's classic text
“The Grammar of Conducting”





Concert Mode

- When the actual performance begins, the player can change, in real time:
 - Tempo
 - Dynamics
 - Articulation
- The score varies according to the ongoing performance and the virtual audience's expectations



Concert Mode



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User Interface

- Must be natural
- Control system must allow anyone to play the game (*a priori* knowledge of the music being played must not be necessary)





User Interface

Possible Options

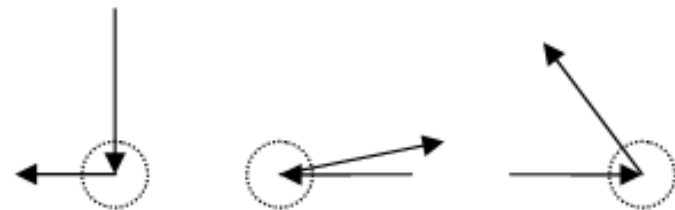
- Camera based
 - Tracking two hands but lighting/background issues
- Device tracking
 - Single hand but very flexible and robust

User Interface

- Gyro Mouse



- Used to track right hand and identify conducting “impulses” which are then analyzed to identify full “gestures”





User Interface

- Mouse movements are used to control:
 - Tempo (number of impulses per unit of time)
 - Dynamics (width of gesture)
 - Articulation (*legato/staccato*: straight or curve movements)
- Note: A standard mouse on a desk can also be used



Music Engine

- Music score is a text file, loaded at run time, with the following format:

Name – Number of voices – tempo indication

Beat time unit – beat time in seconds

voice ID – General MIDI instrument

voice ID – Channel - note ID - MIDI note value - attack velocity
- start beat - duration (in beat units) – pan



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Music Engine

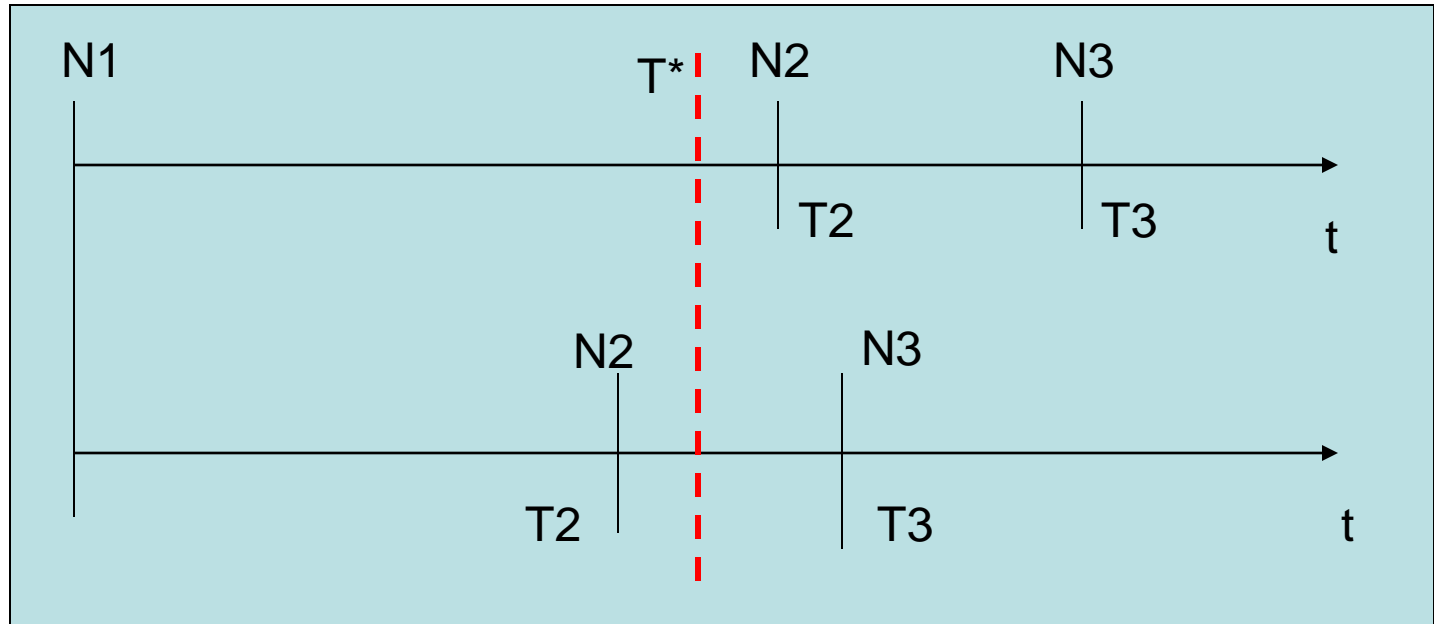
- The score is then processed in real time according to user's movements and notes are sent to the synthesizer of choice (sound card or external equipment) as MIDI messages





Music Engine

- Simulating mistakes: Missing notes



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Audience Model

- The audience model bears the task of evaluating the current performance so as to assign a score and provide valuable feedback to the player.





Audience Model

- It's a Rule Based system checking for
 - Stable tempo
 - Smooth dynamics
- Current values are matched against default values to see whether the player is within an acceptable range
- The rules' weight and range can be modified to set a proper challenge
- Special rules (e.g. bonus points when proper conducting gestures are recognized etc.)



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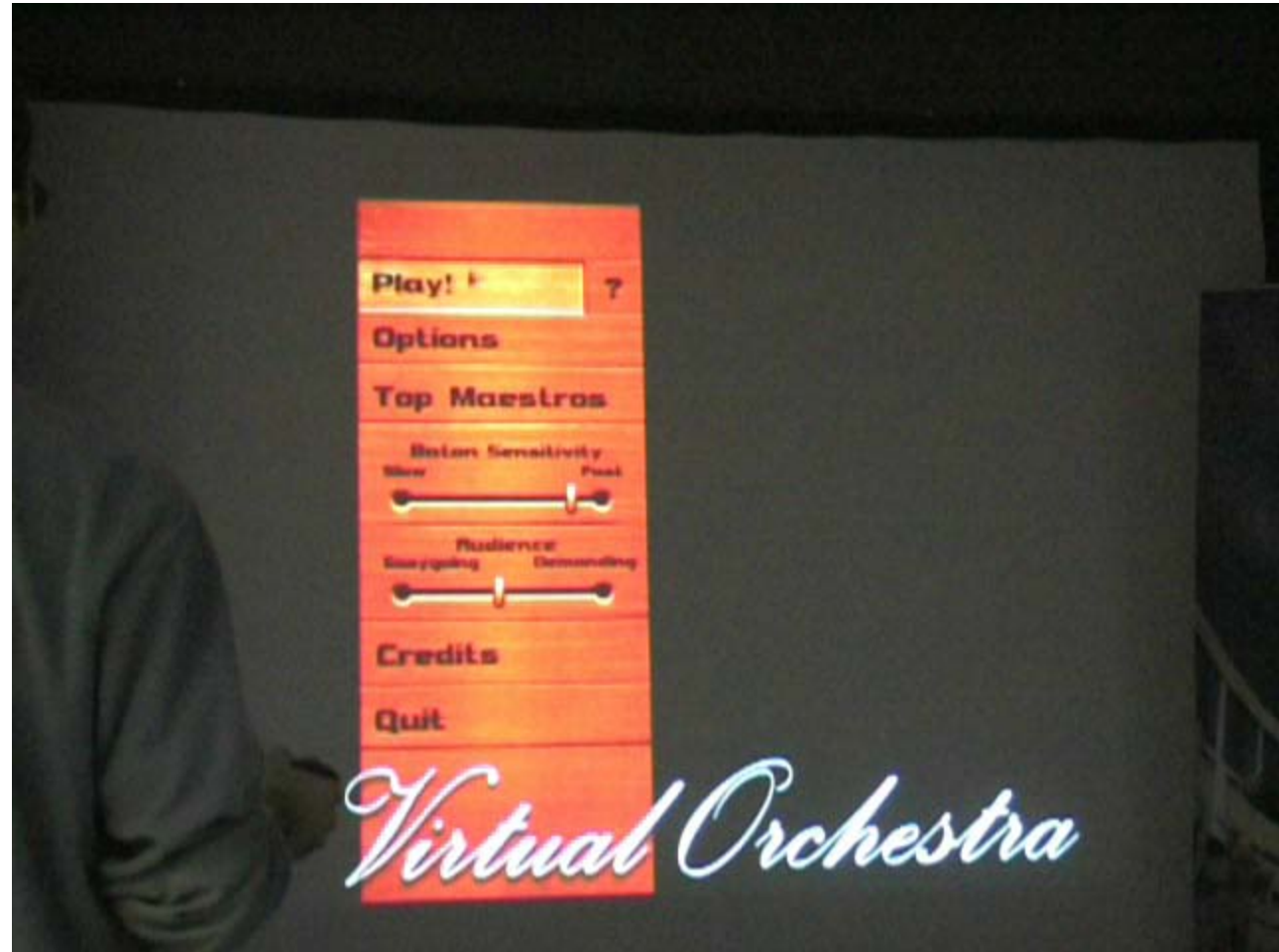
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Testing the game



Testing the game

- Scientific Exhibitions and children classes



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Press coverage



THE STRAITS TIMES, TUESDAY, 21 FEBRUARY 2006, PAGE H8

TECHNOLOGY REVOLUTIONS

Games set to 'read' players' minds

In the computer game of the future, keyboards, mice and other controllers may no longer be needed. In the seventh and final part in our R&D series, **Leung Wai-Leng** looks at how a games R&D centre has developed new ways for us to play

FORGET joysticks and control pads. Gamers one day will play computer games that seem able to read their minds.

Researchers are already working full steam to develop such games at Nanyang Technological University's gameLAB.

One such project nearing completion is the Virtual Orchestra.

Using motion detection technology, the game allows players to conduct a symphony played by virtual musicians, who will perform according to every movement made by the player.

Music students learning to conduct an orchestra will also find the software useful in practising how they wave their baton, as the software tracks the movement of their baton and grades their skill.

This interactive musical simulation has caught the interest of the National Institute of Education (NIE), which may show off the technology in its Classroom of the Future. The "classroom" is a showcase set up by NIE to show how emerging technologies can be used in education.

The Virtual Orchestra can be used to train music students, said gameLAB director, Dr Tony Chan.

But the technology can also be used in other types of games, pointed out the Virtual Orchestra's principal researcher, Dr Roberto Dillon (pictured above). For example, a player could eventually use it to navigate the environment in a 3D game and pull a trigger to shoot enemies.

Now, gamers have to use less intuitive controls like a keyboard and mouse, or a combination of joystick and button presses on a controller for consoles like the Xbox, which takes time to get used to.



PHOTO: DESMOND LIM

PLAYING THE ELECTRONIC MAESTRO

The technology that enables players to control a virtual orchestra with their motions may be used in the games of tomorrow, by allowing them to navigate terrain and moving in 3D. This is how it is done:

- ▶▶ A music score is fed into a program which turns the music into electronic data. The data is then used in a games engine which controls the visuals and sound. The virtual orchestra's game engine also contains an advanced music engine which will generate music based on the player's input.
- ▶▶ The player conducts with a "baton". His movements are tracked and transmitted wirelessly to a computer via radio frequency. The music engine uses the data from these signals to generate a musical effect such as speed or beat variations.
- ▶▶ The software also notes the player's movements and the effects for later analysis.

The creation of interactive technologies which can be used intuitively to play games is at the core of many of the lab's projects.

Said Dr Chan: "The lab looks at the possibilities of technologies five to 10 years down the road... research is focused on developing artificial intelligence, going beyond the keyboard and mouse to interfacing with the machine using technologies that enable human-computer interaction."

Advanced artificial intelligence (AI) software is currently under development at the lab. For military use, the AI simulates realistic behaviours such as working with other computer-controlled characters and trying to outwit the player.

The program will also use ma-

chine-learning, which learns from the strategies used by players and reacts to them. This is what makes AI so challenging and unpredictable. Such advanced computer intelligence may one day be used in commercial games.

Most of gameLAB's five current projects are targeted to eventually reach mainstream users. But first, they will do a tour of duty in military and educational institutions, in a genre called "serious games".

Costing an average of \$250,000 each, every project at gameLAB takes two full-time researchers about two years to develop. The lab also aims to make its technologies available to local game developers, many of whom lack funds to access the latest technologies.

SINGAPORE LAUNCHES VIRTUAL CONDUCTING PROGRAM

Software developers in Singapore are creating a virtual orchestra program to train aspiring maestros using gesture recognition.

Experts and students at gameLAB, the research and development initiative of the School of Computer Engineering at Nanyang Technological University

in Singapore, have been working on the program with principal developer and research fellow Roberto Dillon.

'We are looking for sponsorship and funding for this project to develop the more exciting features of the Virtual Orchestra program, which we believe will eventually become a tremendously entertaining





What's next?

- Adding more content (settings and music)
- Improving the gesture recognition module
- Developing a new “baton”-like device with added functionalities
- Release it as a “real” game!?





From a technical point of view...

- Game developed using 3D GameStudio (Pro)
- Coding in GameStudio's C-like scripting language, music engine as a separate C++ library developed using .NET
- Requirements: Pentium 4 2.0GHz

Credits: Roberto Dillon, Gabriyel Wong, Ron Ang



Thank You for your attention!

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