MyTempo: Musical Conducting Simulation and Its Role in Music Therapy

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Abstract

MyTempo is a desktop application for Windows and MAC OS X machines designed to teach its users about the proper forms of conducting music. It incorporates a novel interface – a gesture-controlled armband known as Myo – to track user movements. Educators who wish to teach the elements of conducting and students who want to improve their conducting may utilize this novel application to do so. MyTempo also serves to connect musical learning with language development. Children with language impairment can integrate MyTempo's music training into their therapies to improve their grammatical skills.

Introduction

In recent years, developers have attempted to integrate technology into musical learning in an intuitive and helpful way. The purpose of this integration is to introduce software that can be adapted to formal training. In the area of musical conducting, the majority of students learn techniques through individual practice. Thus, they often lack feedback on how their conducting can be improved.

Increasing this feedback has been the premise for previous implementations of musical conducting technology. For example, MAES:TRO is a different conducting practice room in which users can alter the tempo and dynamics of an automated musical piece. Prior knowledge of proper hand gestures, body orientation, and eye gaze directions are necessary to initiate these changes (1). The system then presents the user with auditory and visual feedback on his/her performance. Similarly, other musical conducting platforms aim to build a robust system for accurately teaching conducting and providing feedback, primarily focusing on helping student conductors.

Unlike MAES:TRO, MyTempo serves as an introduction to conducting: highlighting the potential for learning music actively through interaction. In the past, many music teachers have been hesitant about shifting to technological means for education. However, recent developments in the field of interactive technology allow for real-time visual representation of movement and sound. This visualization helps improve the technical components involved in most areas of musical training (2).

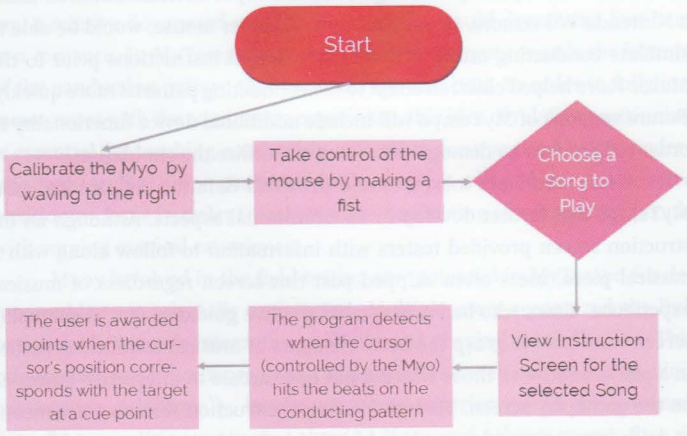

Figure 1 Schematic for the how MyTempo interacts with the Myo.

Visual feedback, when employed correctly, positively reinforces and motivates children as they learn. This feedback, in the form of dynamic graphics, encourages children to become interested in a subject and set their own musical goals. In a group environment, the ability to witness another user's progress can promote constructive competition. These two opposing incentives emphasize the role of visuals in collaborative versus individual settings (2). Additionally, visuals enhance young students' attention when working towards an assigned goal. The feedback provided by MyTempo serves to track the user's progress, allowing for self-improvement when used in both individual and competitive settings.

Musical training has also been effective in improving language development. Prior research has demonstrated a strong positive correlation between rhythm perception and expressive grammatical skills in children with typical development (3). Further research is being conducted to test this correlation in children with language impairment, which is commonly linked to rhythm discrimination. MyTempo provides a variety of rhythms for the user to detect and comprehend, a feature useful for improving language competency through musical therapy.

Materials & Methods

Keyboard

MyTempo was developed on Adobe Director utilizing Lingo code. Adobe Director is a multimedia authoring platform that allows users to create executable applications for desktops. The starting menu of the application was developed such that the user is able to choose the piece he/she would like to play. The user is then free to select any difficulty level for the piece. MyTempo was designed to feature a selection of eight musical works, ranging in difficulty based on various aspects of musical conducting. Works that are classified as easy include common time signatures and follow a consistent tempo throughout the piece. Medium-level pieces include common, yet more complex time signatures in which each beat is subdivided into smaller beats. Hard musical works include unique time signatures, more fluid rhythms, and a tempo that varies in different interpretations.

The interface of each piece includes a conducting pattern, a visual representation of its time signature. Adobe Audition was used to place beats, or cue points, at precise moments of the musical work. Markers along the conducting pattern represent targets for the user to hit at the appropriate

Figure 2 (left) Myo armband positioned on developer Yael Romero's forearm. The armband senses an individual's arm movement as he or she conducts. (right) The Myo armband, shown with its packaging, collects gestural data and sends it to a computer via bluetooth when a participant utilizes MyTempo.

beat. The code confirms that the user's position corresponds with the target at the cue point. If achieved, ten points are awarded to the user, and the marker is enlarged as visual confirmation. The displayed score is a quantitative measure of the user's progress in learning to conduct music. Levels were constructed such that the user's main objective is to follow the conducting pattern accurately and pass through the beats at the correct times.

Myo Armband

MyTempo initially accepted input from a traditional mouse and keyboard. Once the application was fully functioning, Myo was introduced as the gestural component, simulating actual musical conducting. Myo is an armband, positioned on the user's forearm, that utilizes built-in sensors to detect both movement and gestures. The acquired movement data is transferred to a computer via Bluetooth with an adapter connected through USB. Prior to usage, the user places the Myo armband on his/her forearm and waits for it to vibrate. The vibration indicates to the user that the armband has initialized calibration. At this point, the user is instructed to wave his/her hand to the right to complete the process. This gesture was chosen because it is arbitrary compared to conducting movements and would not be misread during the simulation. Calibration is necessary each time the Myo armband is switched between users.

The Myo armband controls the mouse via arm movements. By default, Myo makes this option available through a hidden toolbar. The user is not aware of this toolbar if he/she has not interacted with Myo before. Keyboard Mapper, a utility built into the Myo software, eliminates the need to access this toolbar. A clenched fist is mapped to toggle the mouse on or off. This allows the user to utilize his/her arm as the cursor, which provided a means to simulate conducting movements. Once the user takes control of the cursor, the calibration and setup processes are completed after the user controls the cursor.

MyTempo was tested on the general public in two trials. The first, implemented at Stony Brook's 2016 URECA Celebration, included roughly 40 individuals, and the second, at the Eastern Long Island Maker Faire, included roughly 60 individuals. Users ages 6 to 60 participated in both trials. The test subjects also ranged in their knowledge of music from limited to experienced.

Results

Participants who tested MyTempo at Stony Brook's 2016 URECA Celebration provided data regarding MyTempo's conducting simulation. The test subjects input varied depending on the individual's demographic. Young users between the ages of six and thirteen used a computer mouse and keyboard to conduct, while users ages fourteen and older used the Myo armband. Due to its large size, the Myo armband was unable to calibrate to the younger demographic.

Users with limited knowledge of music prior to using MyTempo offered data in regards to the learning aspect of the program. These individuals experienced initial difficulty in grasping the basics of music conducting, despite receiving instructions at the onset of the simulation. However, these users were able to grasp the conducting patterns approximately four to eight measures into a musical work. Additionally, most of these participants progressed in musical conducting after roughly two or three attempts. Adult users with limited knowledge of music generally took between six and eight measures to adjust to the pattern. Most young users, however, were able to follow the musical conducting patterns after only four measures in a given piece.

Users with formal musical experience provided data on the effectiveness of MyTempo in simulating conducting techniques. Those who fell under this demographic did not find issues with understanding the concepts of musical conducting. However, some individuals did experience difficulties adapting to the application's controls.

Discussion

The data collected at the URECA Celebration and the Eastern Long Island Maker Faire provided insight for MyTempo's role in the classroom. The Myo armband was unable to effectively calibrate to younger users. As seen at the Eastern Long Island Maker Faire, children are able to interact effectively with MyTempo through alternate input devices. Children using a Nintendo Wii remote, as opposed to a computer mouse, would be able to simulate conducting music with a baton. Added instructions prior to the Maker Faire helped children adapt to the conducting patterns more quickly. Future versions of MyTempo will include additional device functionality in order to broaden the demographics that can utilize the simulation.

Users who were inexperienced provided data for determining how MyTempo can further develop in its educational aspects. Although an instruction screen provided testers with information to follow along with a musical piece, users often skipped past this screen regardless of musical experience. Users who had access to interactive guidance on the gameplay screen were able to grasp the basic elements of musical conducting earlier in a piece, relative to those who did not have access to interactive guidance on the gameplay screen. Though previous instruction screens were meant to guide inexperienced users, helpful information during play would further enhance the learning process. As work on MyTempo continues, the gameplay screen will continue to provide assistive steps and guidance for users who know less about conducting.

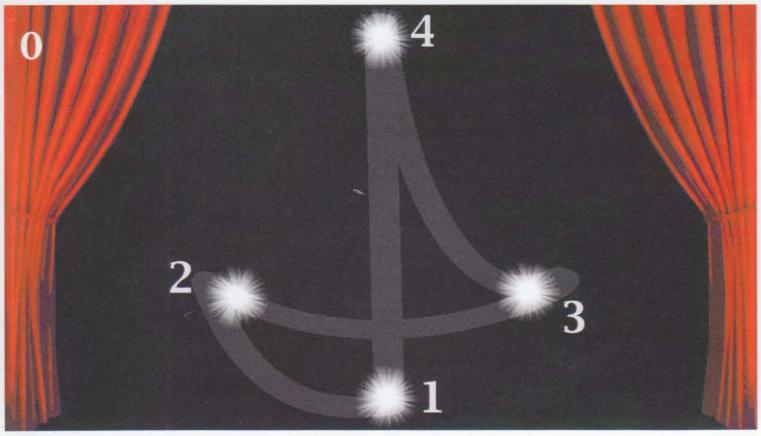

Figure 3 (top) Associate Dean of Students, Mr. Jeffrey Barnett, tests MyTempo as Associate Provost for Academic Success, Dr. Richard Gatteau, and developers, Brandon Cuadrado and Yael Romero, look on. Photo Credit: Professor Anthony Scarlatos. (left) MyTempo screen that allows you to interact with the program and conduct a given time signiture. Shown is 4/4 time. (right) The ending screen that shows you your score and allows you to either retry the piece of music or choose another piece.

Participants with musical experience offered insight into accurately emulating the nuances of musical conducting. Field testers included music teachers, choral directors, and others who have conducted in real ensembles. These users conducted in a MyTempo setting in which the beats in a time signature were denoted by specific targets on the screen that must be hit at the appropriate time. This, however, caused experienced testers to be less immersed in the simulation. They observed that musical conducting does not typically concern itself with specific points on a plane. In conducting, a relative downward motion, for example, would denote the first beat in a measure. In MyTempo, however, there is a target towards the bottom of the conducting pattern that indicates the first beat. In order to fully immerse users with the conducting experience, this idea of relative positioning is essential for teaching conducting with more accuracy and better understanding. As MyTempo continues to develope, it will address this relative positioning issue in order to enhance the conducting simulation for people with varying musical experience.

Many involved in the field testing saw potential in MyTempo for demographics not originally anticipated. Multiple users recognized the link between MyTempo's interactive usability and physical rehabilitation. This relationship has precedence in motor learning research and its role in clinical practice. Additionally, in younger users' experience with the software, friendly competition motivated them to learn and achieve scores that rivaled their peers'. This form of collaborative learning leads to further engagement and progress with MyTempo. Users with experience in education similarly found commonalities between MyTempo's interactive learning and assistive technology in the classroom. Students with cognitive and motor challenges can find treatment with musical therapy through engagement in musical techniques. MyTempo uses interactive technology that could play a role in strengthening this beneficial immersion in music.

With further direction to becoming a more accurate and engaging interactive conducting simulator, MyTempo is finding new potential in music therapy as a field of study. Research and implementation continues to form MyTempo into a system that properly emulates true musical conducting. Music therapy's place in clinical practice is ever evolving to include interactive technologies. Research involving MyTempo and music therapy patients is currently being conducted. The implementation of MyTempo will continue to be true to the real conducting experience and will further highlight

References

1. E. Ivanova *et al.*, MAES:TRO: a practice system to track, record, and observe for novice orchestral conductors. *CHI '14 Extended Abstracts on Human Factors in Computing Systems*, 203-208 (2014). doi: 10.1145/2559206.2580929.
2. L. Nijs *et al.*, Interactive technologies in the instrumental music classroom: a longitudinal study with the Music Paint Machine. *Computers and Education* **73**, 40-59 (2014). doi: 10.1016/j.compedu.2013.11.008http://dx.doi.org/10.1016/j.compedu.2013.11.008
3. R. Gordon *et al.*, Does music training enhance literacy skills? A meta-analysis. *Frontiers in Psychology* **6**, (2015). doi: 10.3389/fpsyg.2015.01777.

Photos Retrieved from:
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