DESIGN OF AN INTERACTIVE CULTURAL HERITAGE EXPERIENCE: THE HISTORICAL ORCHESTRA

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In this paper, we describe the design and implementation of the Historical Orchestra Project, with an emphasis on digital technology. The project is a digital cultural heritage experience that combines art, computing and digital technology. The Historical Orchestra is an interactive installation that is aimed at creating an engaging museum experience by its interactive quality and designed for use with an ancient Turkish illustrated manuscript.

Fig 1. Historical Orchestra installation setup as shown in Media Lab Demoday, 2011, Copyright Ferhat Sen.

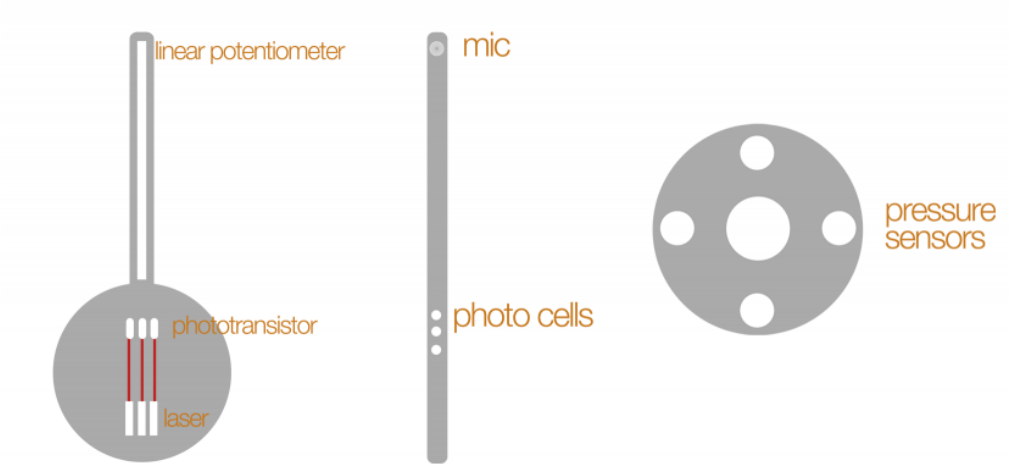

Fig 2. The Sensor Structure of the Digital Instrument, 2011, Copyright Ferhat Sen.

Introduction

The use of digital and electronic media implies a change in the conception of museums and the relationship between the artifacts and the visitors of the museum. In the traditional conception of museums, the artifacts are displayed in spaces under the necessary preservation conditions. Usually being behind glass protection, the artifacts cannot truly be sensed and observed by the visitors, neither by touch nor by looking closer. For example, some artifacts, like illustrated manuscripts, cannot be viewed completely since only one page of the book can be displayed at a time. Moreover, the information displays are often presented as a text next to the artifact, which is not offering an engaging experience. The lack of interactivity that results in the lack of visitor engagement is a major problem of this conception of museums.

In the context of cultural heritage, the use of digital and electronic media cultural heritage can provide new possibilities for visitors and heritage institutions to help them further appreciate the culturally valuable items in the collections. Digital media tools can enable us to create an interaction-based engaging experience through which the educational value can be conveyed. We argue that a multi-sensory experience inviting visitors to actively participate rather than passively see can contribute to conveying the educational value. An answer to the question of how to involve interactive media for an engaging and educational cultural heritage experience, we designed the Historical Orchestra Project by considering the specific qualities of the artifact in question. In this paper we present the design phases, from concept development to implementation, of an interactive audio/visual cultural heritage experience based on a page-couple from an illustrated manuscript.

THE ARTIFACT

Being a significant Turkish manuscript, Surname-i Hümayun (The Book of Imperial Celebration) was written and illustrated between 1583 and 1588 in Istanbul, Turkey. It is a documentation of a 52 day celebration organized by Sultan Murad III for the circumcision celebration of his son, Sehzade Mehmed, in 1582. The text is written in 16th century Turkish and uses Arabic script that follows a right to left layout. Similar to the text, the two-page illustrations also follow the right-to-left layout, where the illustration on the left page is the continuation of the one on the right page (Atasoy 1997, 32).

Comprised of 432 pages of text and 472 pages of illustration, the manuscript presents events and activities which took place during the celebration. In each illustration pair, a different group of artists and craftsmen are depicted in slightly different templates of the Hippodrome Square and Ibrahim Pasha Palace in Istanbul. Among these illustrations, we have selected the one illustrating the procession of musicians shown in Fig. 1.

THE INSTALLATION

The materials needed for the Historical Orchestra installation include one custom-made projection screens, and digital instruments. The selected illustration pair from the manuscript is projected onto two separate projection screens. The image is divided onto two screens in order to reflect the page structure of a book, since the original artifact is a book. In front of the screens, two desks are placed for putting the digital instruments on, and for hiding the irrelevant technological details from the visitors. On the

floor, in front of each instrument, a red circular rug is placed, designating where the visitor should stand. Two speakers are placed near the projection screens for the sonic feedback.

THE INTERACTION

When a visitor stands on the circular carpet in front of a tangible instrument, the system initializes and a corresponding animated musician appears on the screen. When the visitor begins playing the real instrument, the animation corresponds by appearing to play the same instrument on the screen, enacting a scene as on the original page of the manuscript artifact. In addition to the visual feedback, the visitor also receives sonic feedback when s/he plays an instrument. For example if a user plays the ney, s/he hears the sound of the ney playing the note s/he intended. The audience in the balcony and the Sultan on the top left are also interactive. The increase in the number of real players increases the audience in the scene. If there is only one user playing an instrument, a small audience appears on the balcony. When a second user joins, the audience increases on the balcony. After a third user joins, the audience on the ground floor as well as the sultan on the left-most balcony attends to see the performance of the musicians. When all users step off of the carpet, the musicians and the audience disappear.

Concept Development

HISTORICAL DRUMMER

Based on this selected artifact, the first concept was the Historical Drummer, which was an interactive installation that the visitor interacts with through a frame drum. The drum player in the illustration animates and starts to play a simple rhythm, and asks the user to accompany him. When the user starts to play, a human-sized cardboard puppet of the belly dancer in the illustration starts to dance to the beats of the drum created by the visitor. As the user continues to play the drum, other band members start playing to the song, and an audience appears on the projected walls of the installation space.

This concept was presented to two different audiences to see how it is received by different people. The first group was a culturally diverse audience, composed of ten masters degree level art and design students. The second was a group of six Turkish-origin masters and/or doctoral degree level students at different universities from around the world, from various backgrounds, and related to cultural issues. The received feedback showed certain common patterns as well as different point of views which helped us to re-conceptualize the project. Both audiences found it engaging and informative to a certain degree and offered suggestions for improving the interactivity. However, the method was not approved in the same way by the two groups. The first audience did not report any concerns about the perspective we had in the cultural context. Whereas, the second audience found the foundation that the concept was based on as not politically correct. The major criticism was regarding the selection of the dancer as the only interactive element in the installation. It is argued that the image of “dancer” is one of the most stereotypical elements in orientalism.

HISTORICAL ORCHESTRA

Taking into consideration the feedback we received, we decided to build an interdisciplinary team and re-design the concept. The previous design team, which was composed of designers only, was enhanced

with additional members who were also relevant to the project but through a broader range of perspectives. The final team comprised of an oud player, a frame drum player, a ney blower, and a Turkish literature researcher, along with interaction designers and a sound designer.

The resulting concept, the Historical Orchestra, is also an interactive installation based on the same artifact. Instead of one instrument and the real-sized cardboard dancer, it utilizes three tangible musical interfaces and gives real-time visual narrative feedback on screen. The sensor-based musical interfaces enable three users to play three instruments simultaneously. The visuals are based on the event depicted in the manuscript, i.e. the procession of the musicians. The illustration is interactively animated according to the actions of the visitor with the instruments (Şen and Díaz 2011).

Analysis of the Actual Instruments

The first step of the design process of the musical interface was the analysis of the actual instruments in terms of their affordance and intrinsic difficulties. Due to technical limitations, we selected three of the musicians and their instruments as the basis for the musical interfaces. The selected instruments are the Şehrud (Large Oud), the Ney (Reed Flute), and the Zilli Def (Tambourine) (Atasoy 1997, 13-17).

The Şehrud is a large form of the oud, which has been used in Turkish classical music and seen frequently in music-related scenes at illustrated manuscripts. It is a plucked string instrument with a fretless short neck and a round back. It has 5 string groups on the fret board where the player presses onto the string with his/her finger. The strings are plucked around the center of the round back with a plectrum.

The Ney (Reed Flute) is the major woodwind instrument used in Turkish classical music. It is made of a single piece of reed and has to have nine joints/segments that are ideally of equal length, regardless of the length of the ney. The length may vary according to the tuning. A ney has seven holes on it; six at the front for the fingers, one at the back for the thumb. The mouthpiece (başpare), which is located on the first joint is also known as the sound box of the ney, where the lips are placed and breath is blown. The ney is held by two hands in such a way that the fingers can cover the holes, and the upper end is supported by resting on the lips The ney is played by blowing into the mouthpiece at a certain angle with a trained lip placement which novices have hard times in even making sound.

The Zilli Def (Tambourine), a member of percussive instrument family, is a frame drum with cymbals located along the circumference of the frame. It is formed by a skin stretched over a circular frame. The diameter of the frame may vary from about 20 to 50 centimeters. The cymbals are placed in pairs to produce a sound at each tap of the Zilli Def, and four to five pairs of cymbals are used. It is a relatively intuitive act to make music with this instrument; however, creating a rhythm that is within the context of this illustration requires some knowledge which again impossible for novice users to have.

Sensor Structure and Mapping Strategies of the Digital Instruments

Like the acoustic version, the Digital Oud is formed with a neck and a round back having three laser strings, and a fret-board based on a linear potentiometer. On the round back, three low-power, approximately 0.45 mW, lasers are aligned in such a way that each laser points at a photo-transistor (Sparkfun Official Website, 2005). The laser/photo-transistor couple serves as an on/off switch representing the

gesture of a string pluck on the actual instrument. When a user touches the laser, the photo-transistor detects it due to the change in light striking on the sensor. On the neck is placed the touch-based linear potentiometer, which is used to detect the position of the user's finger on the fret-board as shown in fig. 2.

Various mapping strategies are employed for the sensor data coming from the photo-transistor and the linear potentiometer. The data coming from the photo-transistor is either 1 or 0, denoting whether the string is plucked or not. Each photo-transistor is mapped to a different octave in the scale serving as an octave selector. The data received from the linear potentiometer changes between the range of 0 and 1, depending on where the user's finger is. The length of the potentiometer is quantized into ten segments, where each segment represents a base note. Based on this note and on the octave selector, three harmonic notes are generated and played in random times with different random seeds.

Although the Digital Ney looks like the original ney, it is in fact a reduced version with a mouthpiece and only three holes corresponding to three notes. Under each hole, a photo-resistor is embedded to detect the openness of a hole. A microphone is placed into the inner part of the mouthpiece to receive the sound data when user blows.

The digital ney requires a real-time signal processing before the mapping could be done. In order to differentiate a blow from speech, the audio signal received from the microphone has to be processed. Using a bandpass filter (bp~), which passes certain frequencies and attenuates the others, we managed to filter out only the frequencies corresponding to a human blow. This enabled us to use the visitor's blow as the trigger to play the note. The note plays as long as the visitor blows. After being able to separate the blow, we also measured the amplitude of the signal and mapped the amplitude to the volume out of the instrument. In other words, the more powerful the blow is, the higher the volume of the note is. In order not to complicate the instrument, the digital version has only three holes and corresponding three notes. Each of the three holes is mapped to one corresponding note on the real instrument.

The Digital Tambourine has a circular frame and a drum skin over it. Five pressure sensors are placed under the drum skin to receive the input of where the user hits. The hit data from the user input triggers the drum samples. Each pressure sensor triggers different drum samples enabling the visitors to create rhythm by using basic rhythmic structures of Turkish classical music.

The Design Environment

The design environment has two main components: hardware and software. A Macintosh computer with a Mac OS X operating system, various sensors, and Arduino microcontrollers are used as hardware. Arduino, an open-source programmable microcontroller, enabled us to send sensor data to the computer via a USB input/output interface (Arduino 2011).

The software that we used for programming the real-time interaction, signal processing, and playing music is Pure Data (PD), which is a real-time graphical programming environment for audio, video, and graphical processing (Pure Data 2011). An external library called FluidSynth, which is a real-time software synthesizer based on the SoundFont technology, is used to generate the sounds of the instruments. The software that makes the real-time animation possible is Animata, which is a real-time animation software, designed to create interactive cut-out animations (Animata 2011).

Communication from hardware to software took place with Arduino through the USB interface. In order to read and transfer the sensor data from Arduino to a PD environment, communication was necessary between the sensor data and PD. First, an open-source firmware, Firmata, is installed to an Arduino microcontroller thus creating the necessary set of subroutines to use. Then, an open-source PD patch, Pduino, enables the PD to control all features of Arduino with Firmata firmware, including reading the sensor data.

In addition to the communication between the hardware and the software, software-to-software communication was also necessary. The communication line between PD environment and Animata software was the Open Sound Control (OSC) messaging. OSC is a protocol for communication among computers, sound synthesizers, and other multimedia devices.

Conclusion

In this paper we have presented a case study for creating an interaction-based engaging experience as a supplement to a cultural heritage artifact for enhancing the museum visit. By starting with a historical artifact, a 16th century Turkish illustrated manuscript, our case study is an interactive audio/visual installation utilizing three digital musical instruments and giving audiovisual narrative feedback in the form of interactive animation and sound. The actual instruments that are depicted in the illustration were a blueprint in designing the digital instruments. We argue that the experience emanating from the interaction of the visitors with the digital application contributes significantly to the dissemination of the educational value. This study shows how a museum visit can be enhanced by using interactive experiences considering the specific qualities of the artifact in question.

References and Notes:

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