Immersive, Social Applications for 8K Displays

V. Michael Bove, Jr.
Media Lab
Massachusetts Institute of Technology
Cambridge, MA USA
vmb@media.mit.edu

Abstract—Collaborations between the MIT Media Lab, NHK, and Toshiba Memory Corporation are exploring applications for large touch- and gesture-sensing 8K screens, including collaborative educational games, interactive visualizations for extremely dense anatomical datasets, and novel interfaces for exploring large media archives. In this paper I give an overview of the project, describe four representative applications, and provide design and user experience lessons learned.

Keywords: visualization; immersive displays; 8K; games

I. INTRODUCTION

Although much attention is currently being given to augmented and virtual reality, large high-resolution display panels can provide immersive experiences for groups of users with visual quality unmatched by available wearable display devices. While 8K displays are commonly thought of in terms of television broadcasting – most recently public 8K exhibition of video from the 2018 Winter Olympics – we feel that they will have significant commercial potential and impact in educational, professional, and interactive entertainment domains. As an 85-inch diagonal 8K (7680 by 4320) screen has a pixel density of over 100 pixels per inch, it is suitable for applications that provide both interaction at a distance and up-close multitouch input.

The Object-Based Media Group at the MIT Media Lab has ongoing collaborations with NHK and Toshiba to explore applications, content, and user experience for large 8K displays. While many people believe that the data, computation, and bandwidth demands make 8K applications impractical with available storage, processing, and interconnects, this work is proceeding with off-the-shelf hardware. A typical platform for our projects is a Windows 10 PC with two Intel Xeon E5-2670 processors, 128 GB of RAM, one Nvidia P6000 GPU, and a RAID 0 storage system made of solid-state drives (the system for 8K Brain Tour has one Xeon E5-1650, 192 GB, and three GeForce GTX 1080Ti’s). A Sharp 85-inch diagonal monitor is equipped with an optical multitouch screen and a Kinect for Xbox One, allowing both touch and gestural interactions.

One of these projects was developed as a browser application and two others were created in the Unity game engine, and the above hardware configuration provided more than adequate responsiveness and visual quality.

II. 8K TIME MACHINE

In our first experiment we had a goal of enabling viewers of all ages, from young children to the elderly, to browse and select video and audio programming from large historical archives in a simple, efficient, and fun way.

The 8K Time Machine (Figure 1), developed by Yukiko Oshio and Hisayuki Ohmata from NHK, working with the author, uses the interface metaphor of a “time machine” and takes advantage of the ability of an 8K display to show many media items simultaneously at high resolution. The application runs inside a Web browser using HTML5 and Javascript.

In order to browse programming from a particular year, the user first selects his or her decade of birth from a display spanning a century. All screens contain prominent “Home” and “Back” buttons to allow revisiting or modifying previous choices. The screen then changes to one in which the user selects a year of birth within that decade. Popular music representative of that decade plays in the background while this screen is shown, and songs from that decade may be accessed by selecting their titles. Optionally this screen can also include video, audio, still images, or text of news and events representative of the decade.

Once the year of birth is selected, the screen changes to one corresponding to the selected year. Popular music representative of that year or decade can play in the background while this screen is shown, and optionally the songs from that year or decade may be accessed by selecting their titles. Again this screen can also include year-representative video, audio, still images, or text. On this screen the user selects an age to “revisit.” Once the age the user wishes to relive is selected, the screen changes to one related to the corresponding year. Again, popular music representative of that year or decade can play in the background while this screen is shown, and optionally the songs from that year or decade may be accessed by selecting their titles. This screen too can also include representative video, audio, still images, or text.

After a brief time on this screen the user then sees a matrix of television programming selections from the selected year, playing as loops. On an 8K screen, 64 standard-definition videos can play at full resolution.

Selecting any of the displayed programs brings the selected program to the screen, where it is displayed in a frame depicting a chronologically-appropriate television set. An animated character “watches” the program with the viewer; the software controlling this companion can be programmed in such a way (for example but not limited to a state machine model) that the companion responds directly to characteristics of the television program being shown on the screen or to accompanying metadata, for example becoming excited...
during action scenes, blushing during love scenes, or laughing at humorous scenes. Upon the completion of the selected television program (or upon selecting the “Back” button) the screen returns to the programming matrix; upon selecting the “Home” button the screen returns to the decade-of-birth screen or to some other “Home” screen from which the search process can be re-entered for that user or started for a new user.

Experts in design for older adults and for children have been consulted in the design of the interaction model, and the system has been used by many viewers ranging from young children to senior adults, whose suggestions have been incorporated to make navigation and control easier and more intuitive.

III. 8K BRAIN TOUR

Expansion microscopy, a technique developed by the Synthetic Neurobiology Group at the MIT Media Lab,[1] infuses biological specimens with polymers that uniformly expand in water, allowing optical imaging of smaller anatomical details than would otherwise be possible. When applied to neural tissue, this technique can be combined with the Brainbow process,[2] in which individual neurons can be made to fluoresce in random colors, allowing better visual tracing of neural connections.

A roughly 1.2 mm x 0.6 mm x 0.2 mm region of the hippocampus of a mouse produced a volumetric dataset of 25,000 x 14,000 x 2000 voxels, amounting to 5 TB. This was created by digitally stitching an 18-by-10 array of “tiles,” each corresponding to a single field of view of a Zeiss Z.1 light sheet microscope (1400 x 1400 pixels). The microscope creates a sheet of light to optically section the specimen within the field of view, resulting in 2000 slices per tile.

An 8K visualization system (Figure 2) developed by Yosuke Bando and Kazuhiro Hiwada from Toshiba Memory Corporation, Shoh Asano from the Synthetic Neurobiology Group, and Takahito Ito and Mika Kanaya from NHK allows a user to investigate the brain sample at resolutions as fine as 50 nm per pixel in the most zoomed-in state while maintaining a large portion of the sample (0.4 mm horizontal) on the display. When the entire sample fills the screen, rendered pixels correspond to 160 nm regions of the specimen. Since nanometer-scale elements of the brain are interconnected at millimeter or larger scales, understanding the brain’s neural connectivity requires simultaneous microscopic and macroscopic views, and a large 8K screen is a good match to this requirement.

Because an entire 5 TB dataset can’t reside in the PC’s main memory, supporting interactive rendering requires rapidly transferring appropriate data from the storage device to the GPUs in the PC. To allow interactive operation at transfer rates supported by solid-state drives, the volumetric data is partitioned into sub-cubes stored in a multiresolution format.

IV. COLLABORATIVE GAMES

We have often observed our large-screen 8K applications attracting groups of users; consequently we have begun seeking to develop experiences that are inherently collaborative and social. Since the Kinect allows tracking up to six people and the touchscreen is also large enough for multiple users, the design problem here is to create enjoyable and possibly educational tasks that take advantage of the high quality visual experience of the 8K screen while posing a challenge that can best be solved by cooperation among members of a team.

Our first example is a gesturally-interfaced game that is also a social experience and a dense data visualization. In this application, developed by Pedro Colon-Hernandez in the Unity game engine and called “Where’s Pedro?” (Figure 3) players work together to look for a hidden person in an extremely densely-rendered procedurally-generated cityscape. It is possible to switch the game display on-the-fly from 8K to 4K or HD in order to demonstrate the difference in the experience as resolution changes, and the complexity of the city can be varied depending on the skills of the players.

The development of “Where’s Pedro?” led to some valuable insights into the use of the Unity game engine for complex 8K projects, and we applied these to a second application called “8K Searchin’ Safari,” (Figure 4) created by Kaori Kikuchi from NHK. Here users work together to explore a simulated animal habitat while traversing a nighttime jungle. Each player’s right hand becomes a flashlight and the goal is to find and “collect” (by illuminating) as many nocturnal animals as possible. Because each flashlight illuminates only a limited region of a complex scene, and because sometimes more than one animal is briefly visible at a time, optimal play requires the team to collaborate strategically to avoid missing animals. The application also highlights 8K television’s ability to show highly detailed, true-to-life imagery.

ACKNOWLEDGMENT

The work described in this paper has been supported by consortium funding at the MIT Media Lab and by the Ultimate Media special interest group. The author sincerely thanks our NHK and Toshiba Memory Corporation collaborators for their technical and creative contributions, and their organizations for financial support.

REFERENCES

Figure 1. Representative screens from 8K Time Machine: year-of-birth selection screen, program matrix, and selected program playing along with animated companion.

Figure 2. 8K Brain Tour.
Figure 3. “Where’s Pedro?”

Figure 4. “8K Searchin’ Safari.”