

MAKER: Public Engineering: Informal Interactive Video and Electronic Poster Hallway Learning Experience

Dr. Austin Talley P.E., Texas State University

Austin Talley is a Senior Lecturer in the Ingram School of Engineering at Texas State University and a licensed Professional Engineer. His research focus is in design methodology with Universal Design and engineering education. He has received his B.S. from Texas A&M University and M.S.E. and PhD from The University of Texas at Austin.

Dr. Kimberly Grau Talley P.E., Texas State University

Dr. Kimberly G. Talley is an assistant professor in the Department of Engineering Technology, Senior Research Fellow and Maker Space Co-Director for the LBJ Institute for STEM Education and Research at Texas State University, and a licensed Professional Engineer. She received her Ph.D. and M.S.E. from the University of Texas at Austin in Structural Engineering. Her undergraduate degrees in History and in Construction Engineering and Management are from North Carolina State University. Dr. Talley teaches courses in the Construction Science and Management Program, and her research focus is in student engagement and retention in engineering and engineering technology education. Contact: kgt5@txstate.edu

MAKER: Public Engineering: Informal Interactive Video and Electronic Poster Hallway Learning Experience

Abstract

Through class projects and assignments, students create a wide range of interesting content. How can faculty use the student video and poster projects after the semester is over? This project is focused on the production of a system that can be used in the hallway to allow students to interact and learn from videos and electronic posters. The term public engineering was chosen to be analogous to the field of public history as the aim here is educate the public about engineering topics. This public engineering display is primarily made up of a PC running windows and 32-inch LCD TV. The computer is surplus from a student computer lab upgrade, and the TV/Display was mounted to a wall in an engineering academic building. A hole was drilled in the wall to connect the TV monitor to the computer sitting in the room behind the display. A metal control box was built and mounted to the wall below the display that houses arcade control buttons and an Ultimarc Mini-PAC control board. Using the LabVIEW programming language, an application was built that allow the user's pressing of the arcade buttons to emulate keyboard strokes. The application then uses that information to log the user's answers to content questions or their requests for new content in Excel files. LabVIEW displays images of the posters or makes calls to Active X controls to play the videos. The program is setup to read file folders and to randomly select which content is displayed. As such, new content can be added without changing the program by simply adding new files to the appropriate folders. This paper will describe the construction of this interactive display to allow others to replicate the experience. A laptop-based version of the display system will be brought to the conference for demonstration purposes.

Introduction

Through class projects and assignments, students create a wide range of interesting content. How can faculty use the student video and poster projects after the semester is over? This project is focused on the production of a system that can be used in the hallway to allow students to interact and learn from videos and electronic posters. The term public engineering was chosen to be analogous to the field of public history as the aim here is educate the public about engineering topics. This paper attempts to describe the construction of the interactive display system. The description is broken up into three areas: user experience, materials and installation, and software.

User Experience

The Informal Interactive Video Hallway Learning Experience is implemented on the user side in the hallway with a video screen and a "button" box as shown in Figure 1.



Figure 1: Informal Interactive Video Hallway Learning Experience: Hallway side

The user walks up to video monitor displaying black screen saver with the text, “Press any button.” Once the user presses a button the screen saver turns off. Next the user is prompted to, “Press any key to watch the introduction video” as shown in Figure 2.

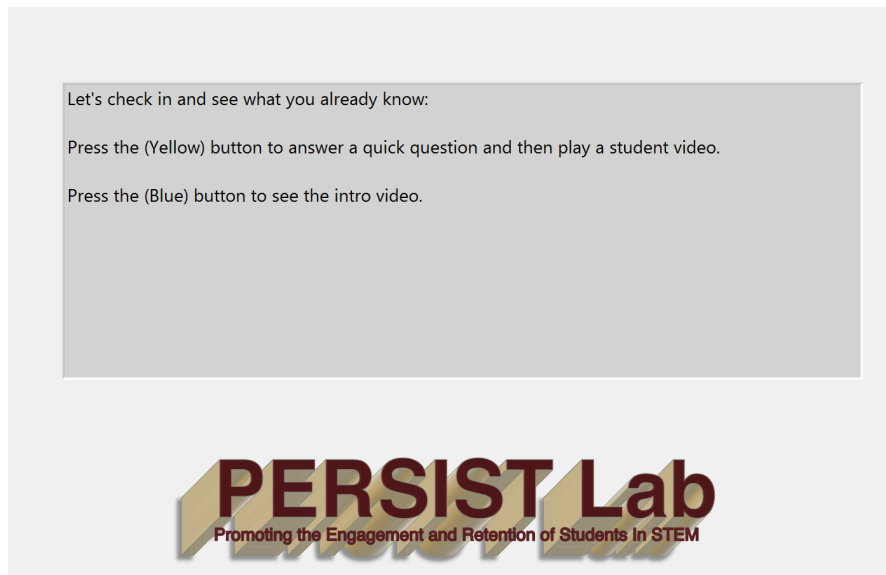


Figure 2: Opening Screen

The opening screen disappears and the lab introduction video plays for 30 seconds. An image from this video is shown in Figure 3.

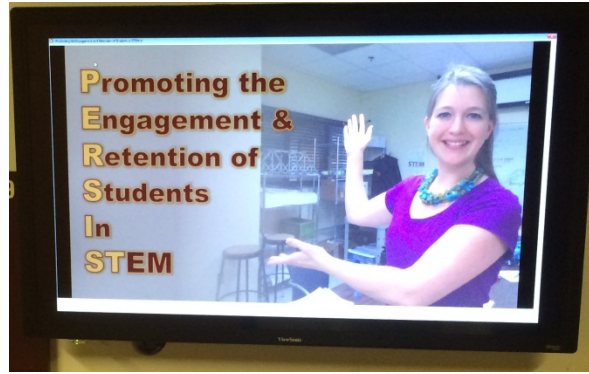


Figure 3: Introduction Video

The screen displays a question asking the user what they would like to do next, either answer a question in order to watch a video or watch the introduction video again. This screen is shown in Figure 4.

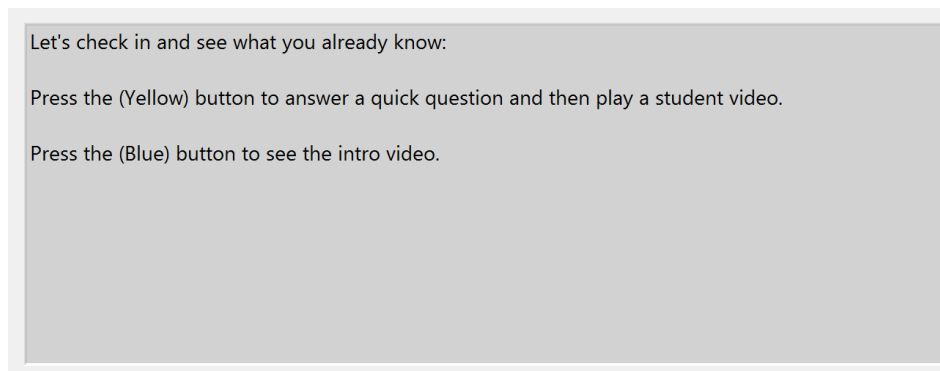


Figure 4: Screen Following the Introduction Video

If the user selects blue button the display will play the introduction video again and then return to this screen (Figure 4). If the user selects the yellow or any non-blue button then the system selects a random student video project and pulls one of the related quiz questions. The quiz question, which has four or five multiple-choice answers, are then displayed. An example of one of these questions is shown in Figure 5.

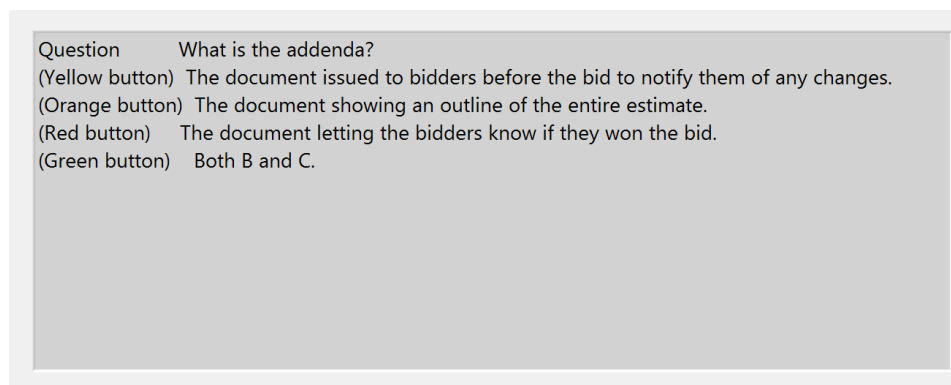


Figure 5: Example of Question Corresponding to Student Video Content

After the user presses on of the buttons they hear clapping if their answer is correct and nothing if it is incorrect, then the corresponding student video is played. Figure 6 shows and example of a student video that is in the current system.

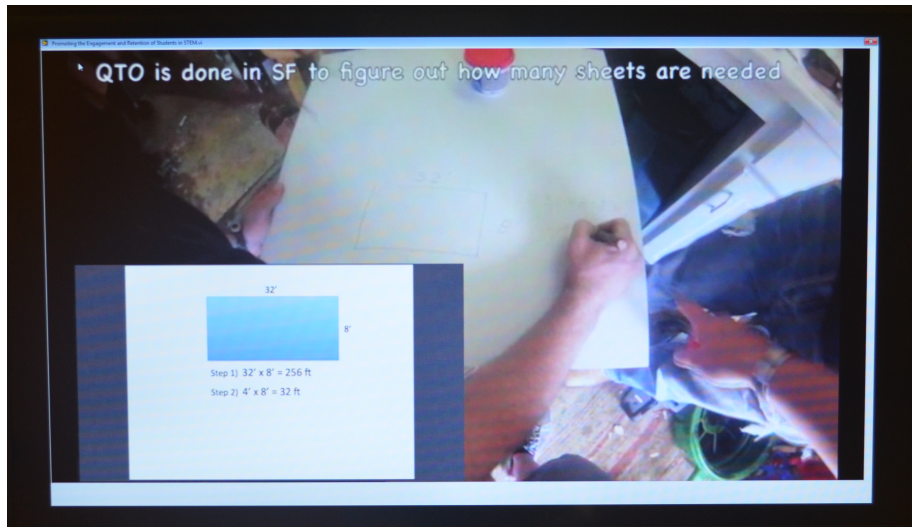


Figure 6: Example of a Student Video

When the student video is finished, the user sees the same question they were previously asked (Figure 5). Once again if they answer the question correct they will hear applause. After the post-video question is answered the user will see screen shown in Figure 4 asking if they want a student video or the introduction video. This sequence will continue endlessly, or until more than five minutes have elapsed without a button being pressed. The system will then revert to its opening screen, as shown in Figure 2, to reset the experience for the next user.

Materials and Instillation

The Informal Interactive Video Hallway Learning Experience was made using the materials listed in Table 1. Table 1 also lists the source for each component. The system cost about six hundred dollars for materials, not including the software and surplus desktop computer.

Table1: Material List

Items	Source
Computer	(using surplus desktop)
LabVIEW software	(school has license)
32" LCD TV	CDW-G
TV mounting Bracket	CDW-G
10' HDMI to DVI Cable	CDW-G
3.5mm Stereo audio cable 10'	CDW-G
Mini-PAC With Harness	Ultimarc
USB cable 10'	CDW-G
Classic Pushbuttons from Happ Controls (five colors)	Ultimarc/Happ Controls
Control box (for pushbuttons and Mini-PAC)	Made in University Shop

The system could likely be acquired for less if purchased on the open market instead of through a state procurement system. The user side of the system is in a hallway just outside of a research lab. The TV is mounted to the wall with a standard TV mounting bracket. A hole in wall was drilled behind the TV to allow wires to pass from the TV into the control box. HDMI end of the HDMI to DVI cable connects to the back of the TV and the cable then passes through the hole behind the TV into the research lab to connect to the computer. Also passing through the hole is the TV power cord and the 3.5-mm audio cable. The control box contains the Mini-PAC control board and five colored push buttons as shown in Figure 7 where the front panel was removed to show the inside of the control box.

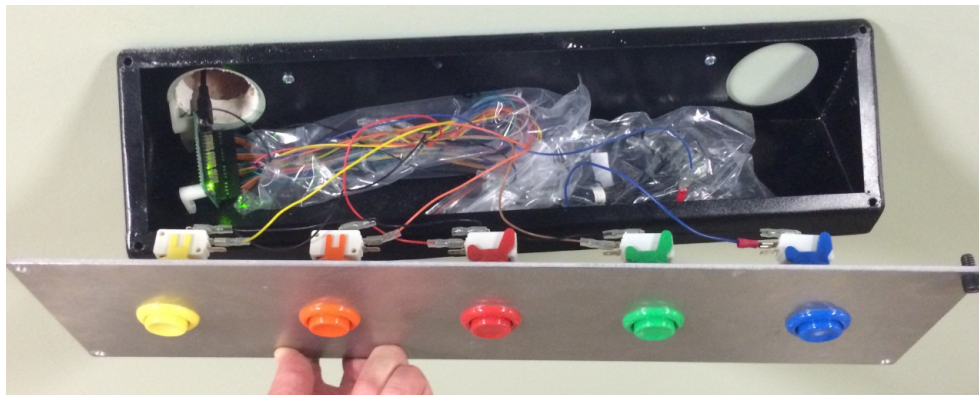


Figure 7: Control Panel

The Mini-Pac control board is visible on the left side of Figure 7. The included wiring harness was used to connect to the five push buttons. The control board was designed for DIY custom arcade cabinets. The control board was connected to the computer with the USB cable passing through the wall. The computer recognizes the control board as a second keyboard. Therefore, when a user press a pushbutton the computer interprets that as a letter being pressed on a keyboard. Figure 8 shows the surplus computer inside the research lab as well as the hole drilled through wall to allow the cables from the display to pass through the wall to the computer.



Figure 8: Lab Side of the Informal Interactive Video Hallway Learning Experience Display

The lab side of the system consists surplus computer left over from a computer room upgrade. The computer is setup with a split display with one monitor being in the lab and the other in the hallway (the TV/video display). When the system is running and not being serviced, the traditional keyboard, mouse, and Ethernet cord are removed from the computer to prevent interruptions. Specifically the Ethernet connection was removed to keep the system from being interrupted by software auto updates prompts, which would block the system as they could not be acknowledged with the push buttons. Removing the keyboard and mouse also helped prevent lab users from unintentionally stopping the system. For future designs a Bluetooth keyboard and a single display may be the best system.

Software

The program for the interactive display was written in the LabVIEW development system. LabVIEW is a graphical based language was used for this system due on of developer being familiar with using the language and the University department had a site license for the software.

The software program for this system was organized in a state machine architecture [1]. This setup involves using a case structure inside a state machine. For this system there were five states described in Table 2. Further, the LabVIEW programming for the states is shown in Figures 9-13.

Table 2: States Used in Program Architecture

State	State Name	State Description/Action
0	Get next file	This case randomly selects the next video and question to ask.
1	Check for key stroke	Waits for a push button to be pressed. This is the most common case the program uses.
2	Play video	Uses an ActiveX container to display and play the next video.
3	Ask a question	Displays to the control panel the question to be asked.
4	Write file	Writes data to a file.

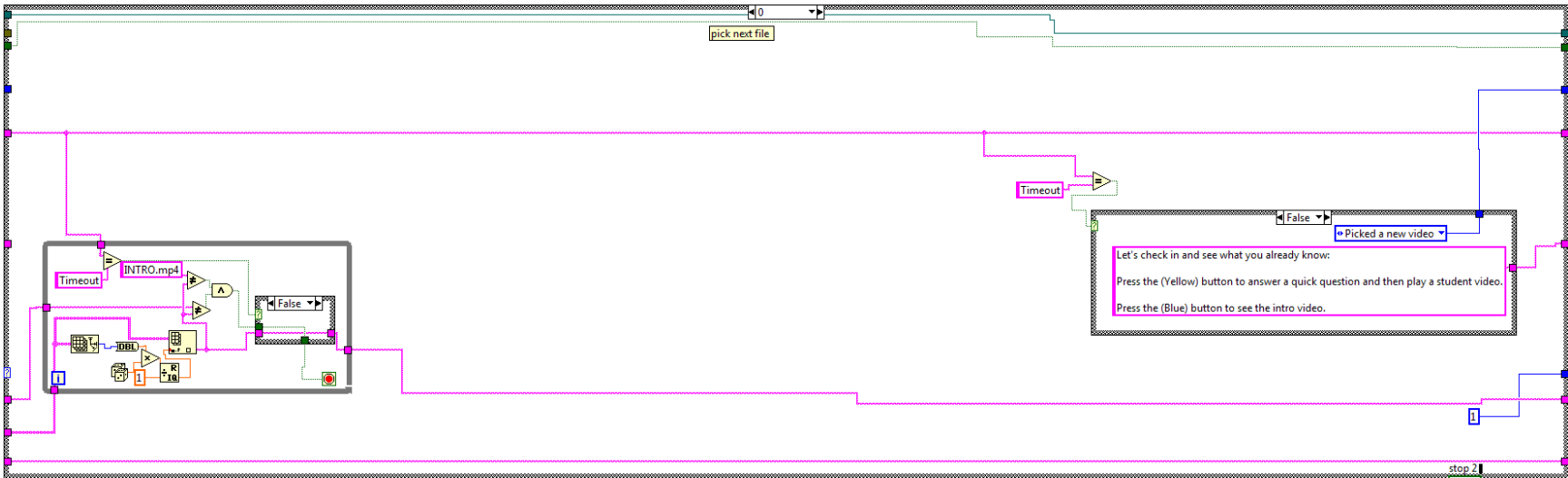


Figure 9: 0 Get next file

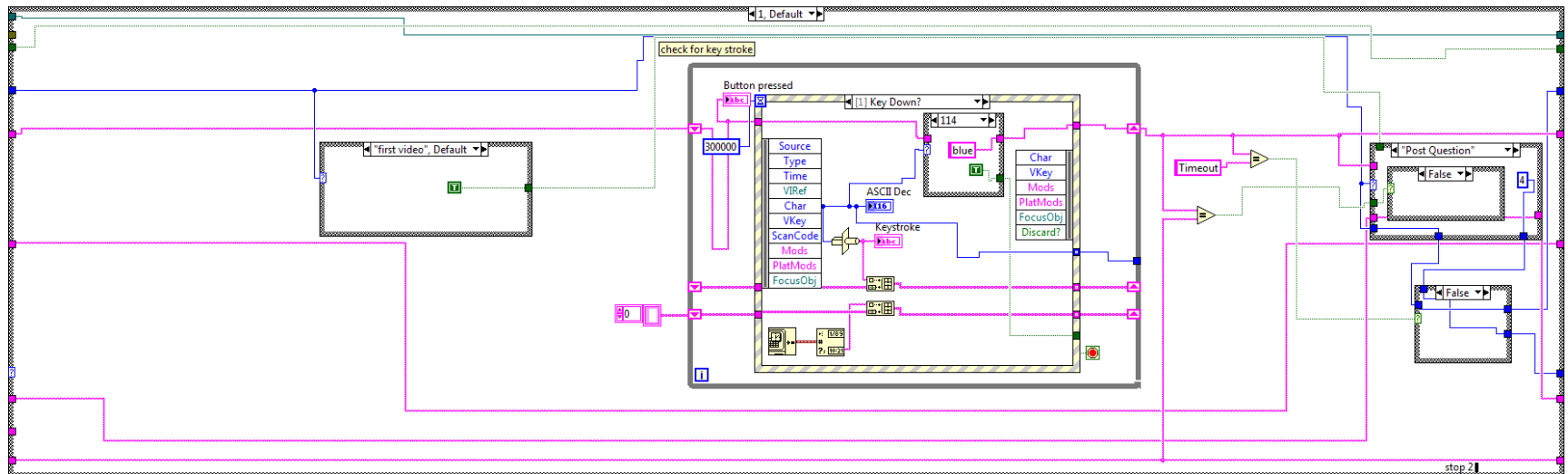


Figure 10: 1 Check for key stroke

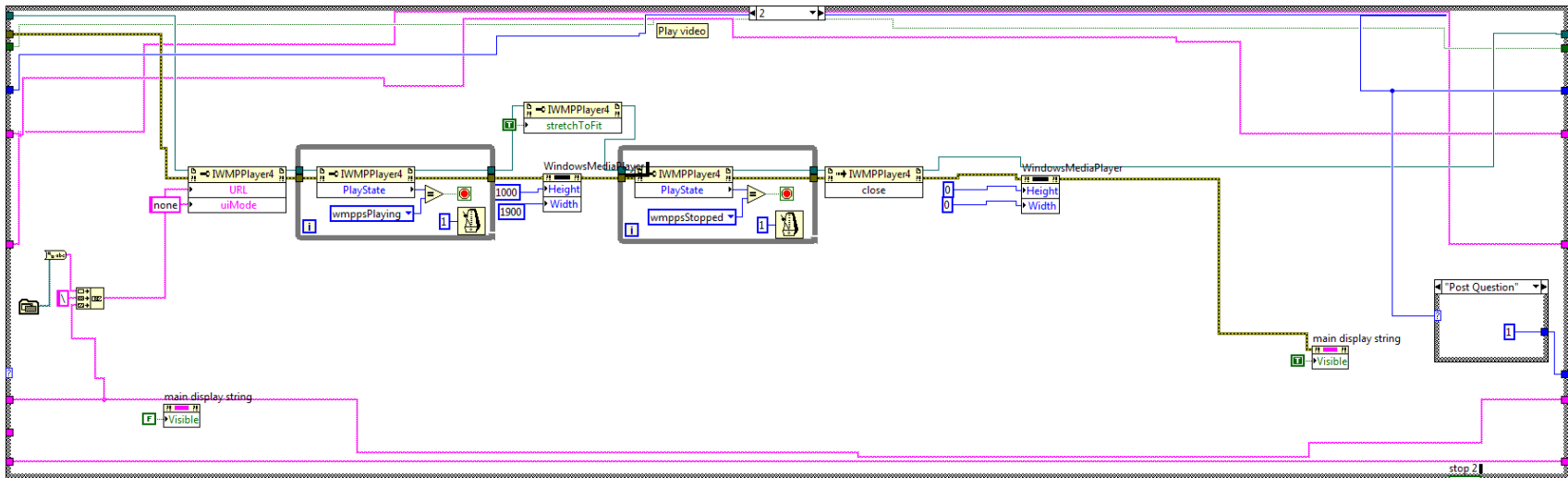


Figure 11: 2 Play video

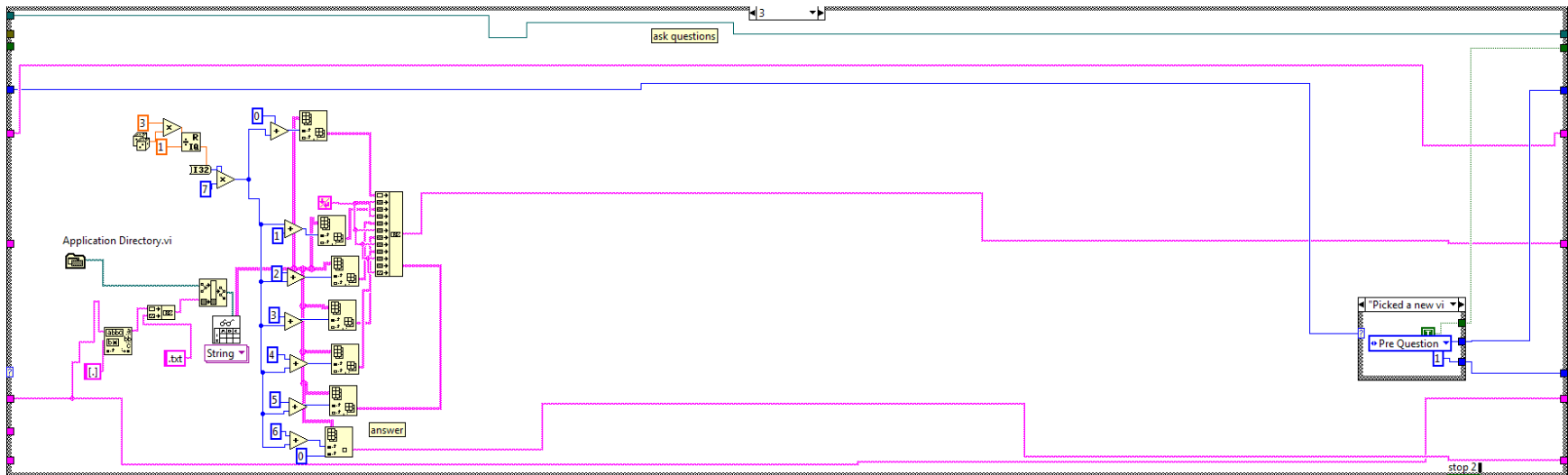


Figure 12: 3 Ask a question

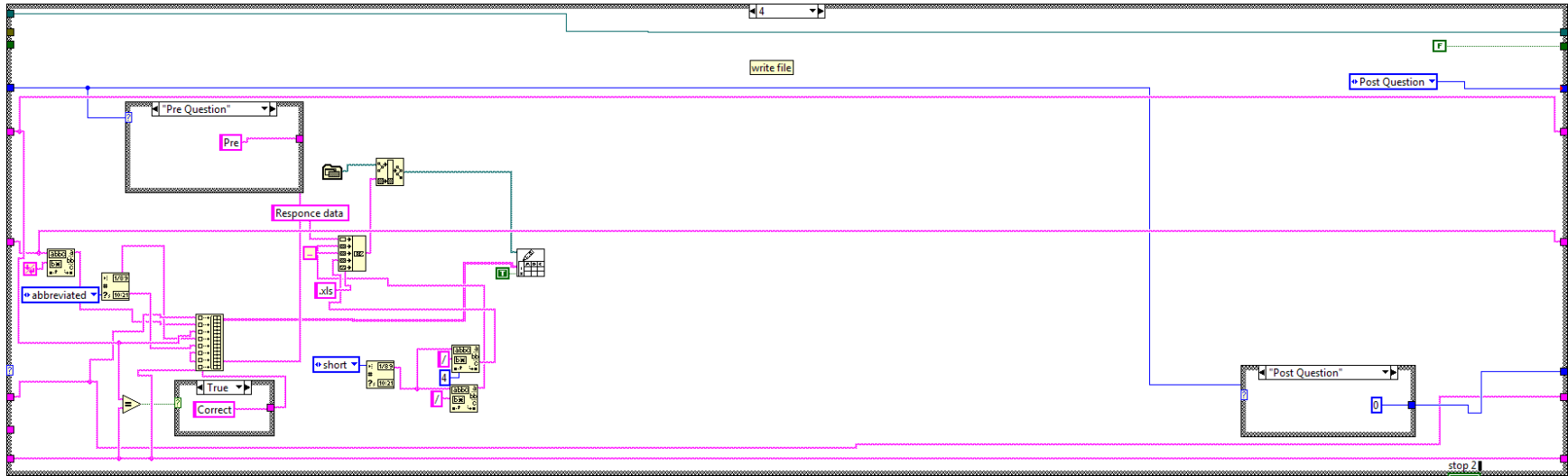


Figure 13: 4 Write file

Lessons Learned and Conclusions

- Find the right balance of the output volume for the display. The users need to be able to hear the video, but the level should be respectful of nearby labs/offices. For this particular display, it is located amongst many research labs and so it was not too sound sensitive. Still, the sound was frequently adjusted by others through the TV volume controls.
- Find a way to disable auto-updates on the host computer, instead make a plan to manually update software as needed. The auto-updates on this computer required the user to approve the update. As such, it stalled the video display by having the pop up window on the other monitor that required action before the computer would process any other command.
- If purchasing a computer for a similar display a small CPU, such as the Apple Mac Mini, could likely be mounted to the wall near the ceiling. This arrangement would allow the system to be installed on one side of a wall only (no need to drill through the wall to access the CPU).
- Anecdotally, this project has been an interesting way to engage with the public outside of a scheduled tour. The logged data will need to be analyzed in future work to determine if there is a length of video that is too long (users walk away), if people are improving their quiz answers, if users tend to always press a certain color button without regard to the quiz questions, etc.

References

- [1] National Instruments, LabVIEW User Manual, April 2003 Austin, Texas: National Instruments Corporation.