

Music Instruction in a Virtual/Augmented Reality Environment (CAVE 2 and Hololens)

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Acknowledgements

Professor Johnson

Lance Long

Arthur Nishimoto

Juan Trelles

Tyler Knighton

All the other faculty and students at
EVL

SONATA.

Op. 12, No 1.

Allegro con brio.

VIOLIN.

L. van Beethoven

Sonata 1.

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Looks simple right?

3 Keys to Reading Music

Intonation (pitch of notes)

Tempo (speed)

Rhythm (arrangement of sounds)

Why VR?

Starting a new piece can be a daunting task as many novice and intermediate players don't know what the piece sounds like, how fast to go, or how to play some rhythms. They usually need the help of an advanced musician. A virtual reality application can give the user visual and audio cues that will help them understand the piece while interacting with their instrument.

HARMONIX



Other examples of Music and VR

Device #1: Microsoft HoloLens

What is HoloLens?

According to Microsoft, “Microsoft HoloLens is the first fully self-contained, holographic computer, enabling you to interact with high-definition holograms in your world.”



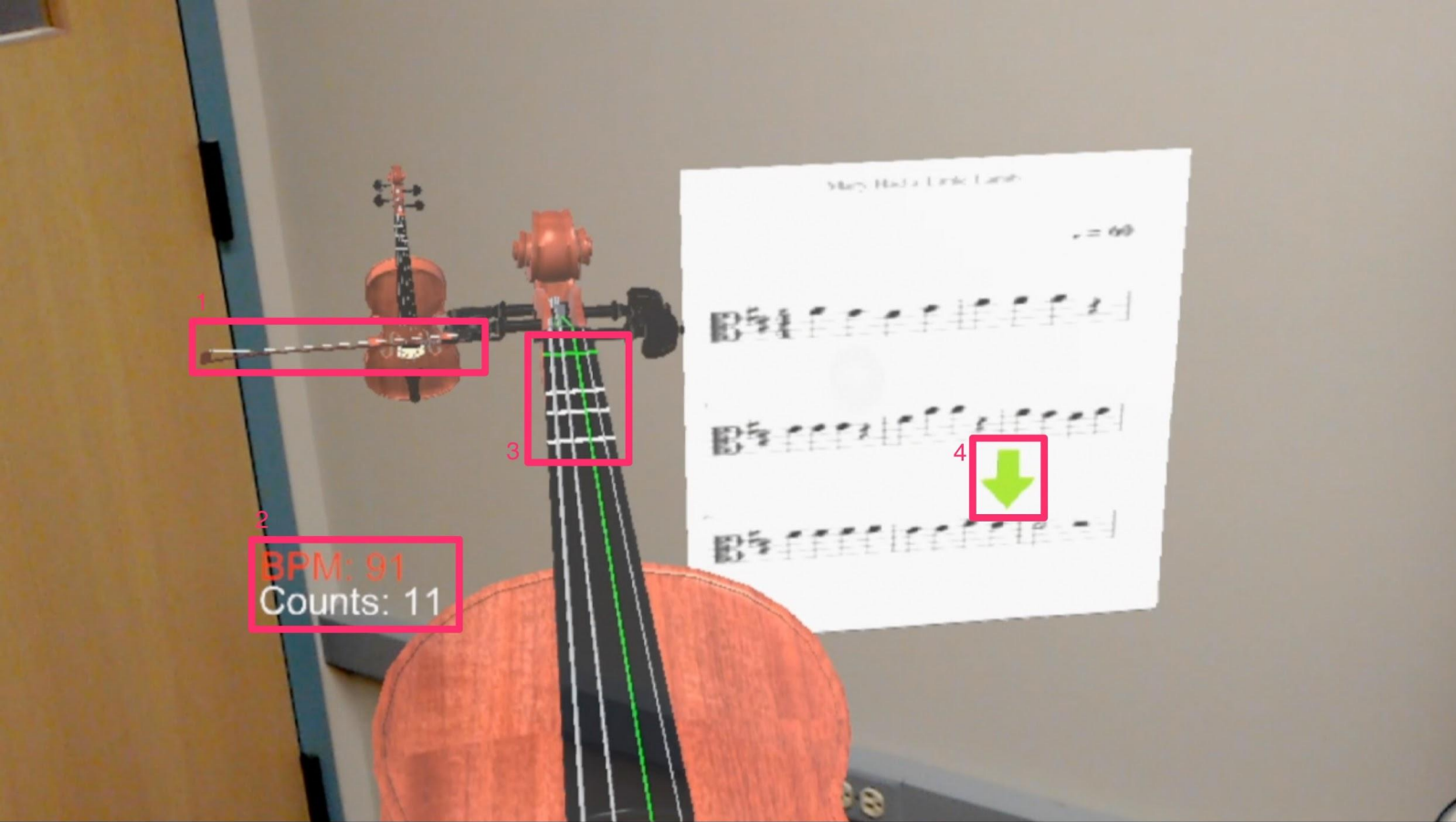
Pros and Cons

Pros:

- Self contained
- Augmented reality-user can see the environment he is in
- Portable
- More accessible (in a few years)
- Good audio, headphone support

Cons:

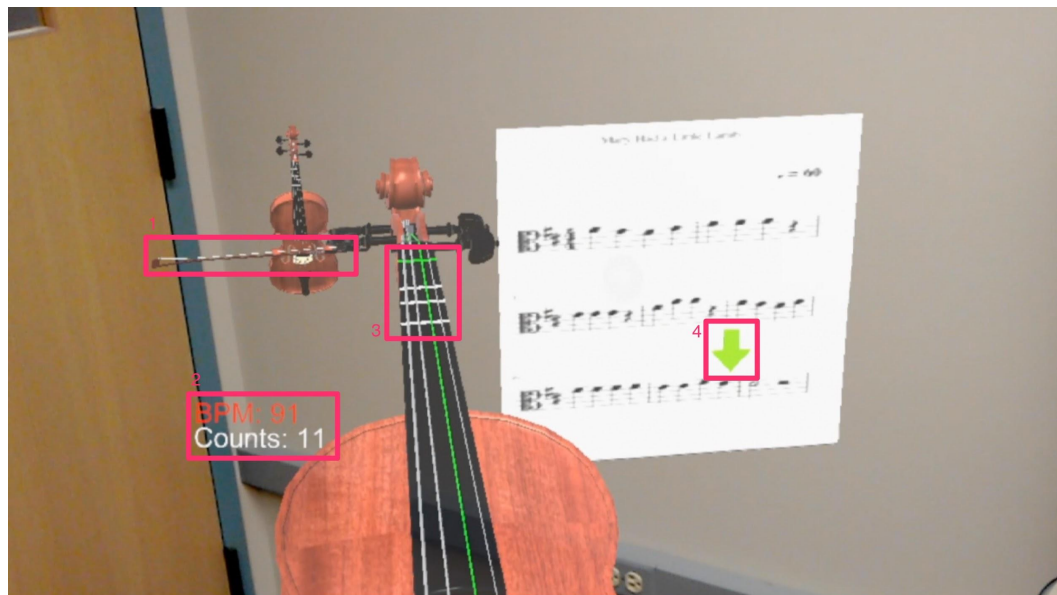
- Fairly limited input options (I had to connect a bluetooth keyboard)
- Text can be hard to focus on
- Not very comfortable for long periods of use
- Can't track user's hands/body
- Tiny field of view



Hololens Interface

Hololens Interface Explained

1. **Bow Direction**-Lets the user know which way their bow should be going
2. **Tempo**-User can tap space bar to set their own tempo, so they can go at whatever pace they are comfortable with
3. **Fingering**- “Tapes” on the neck of the instrument light up green when the user’s finger need to be placed on them
4. **Sheet Music**-Green arrow lets user know where they are in the piece so they don’t get lost.



Other Features

- Metronome-user can turn this on or off (letter 'M' on keyboard)
- Lesson can be paused (letter 'P' on keyboard)
- Correct notes are played through the speaker so user will know if they are “in tune” (can be toggled with letter 'Q' on keyboard)
- User can go back to instructions page at any time (letter 'I' on keyboard)



Video Demonstration

Improvements and Future Goals

- Getting input from microphone that can analyze pitch
 - Microphone only recognizes words
- User should be able to upload their own music files
 - MIDI
- Different instruments
- Higher resolution graphics

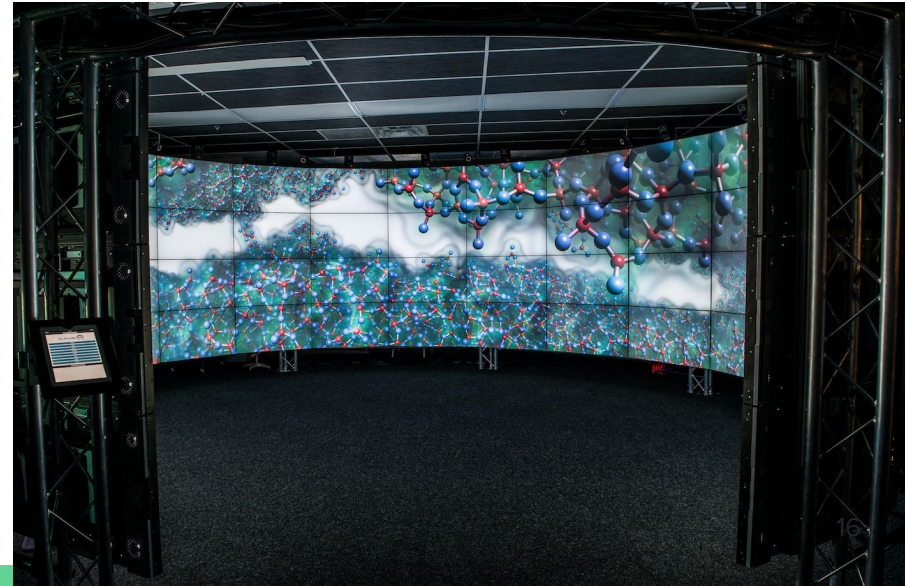


The image shows a musical score with three staves. The first staff begins at measure 8 and features a 'percussion' label above it, with a green box labeled 'A' positioned above a vertical line. The second staff starts at measure 16 and includes a 'ff' dynamic marking. The third staff starts at measure 20 and has 'mp' and '< mf' dynamic markings. The score contains various musical notations, including notes, rests, and accidentals.

Device #2: CAVE 2

What is CAVE 2

CAVE 2 is a large-scale virtual reality environment where the user is immersed by 3D panels in 320 degrees. Infrared cameras can track the user's head and, in this case, bow and instrument. User can walk around and interact with the environment with PS3 controllers.



Pros and Cons

Pros:

- Larger, more comfortable environment
- No heavy HMD on your face
- Bigger, more immersive environment
- Can be used with more than one person (duets, quartets etc.)

Cons:

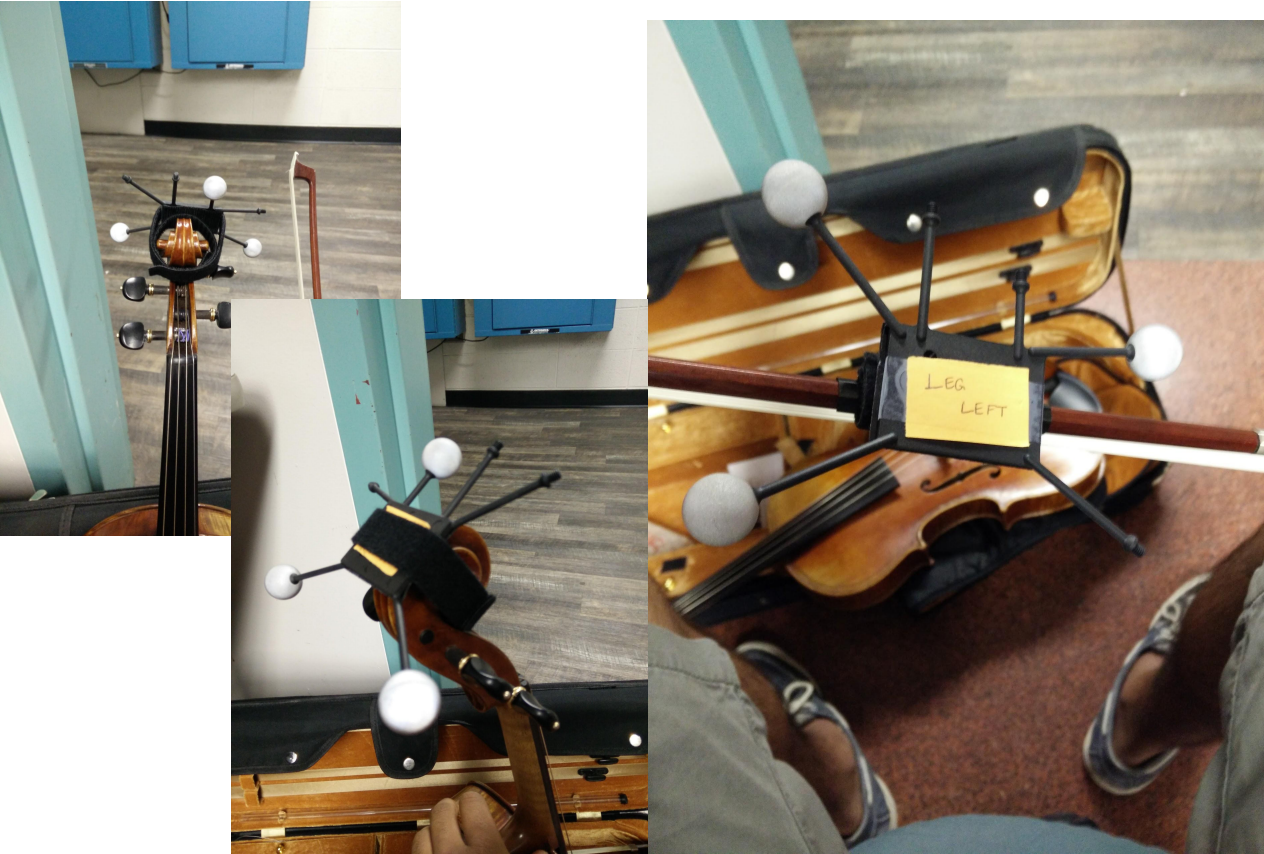
- Not portable
- Expensive
- Screen real estate not optimum for this application (lot of wasted space)
- No microphone input
- No headphone support (bluetooth may work)

Tracking-First Try



At first I thought I'd use the PS3 controllers to control the virtual instrument like shown here

Tracking-Second Try



I then decided that it would be a better idea to place trackers on the instrument itself so the user can play the instrument while interacting with the virtual one.

CAVE 2 Interface

- Similar to that of the hololens, but user can see the entire instrument as well as their bow
- More immersive
- Virtual instrument moves when user moves the real instrument
- Includes a stand with sheet music on it, something too big to be portrayed by the Hololens

Pictures and Videos to come:



Improvements and Future Goals

- Same as for Hololens
- Resolution wasn't that big of an issue
- Multiple musicians in the CAVE (duets, trios etc.)
 - Collaboration on pieces



Considerations/Challenges

For Hololens:

- Changing the speed of an audio file in Unity changes the pitch, which would be detrimental to the user, so I had to make each not a separate sound file and speed up the space between playing each note.
- Tiny field of view on Hololens made me have to pick and choose what part of the instrument the user could see

For CAVE 2:

- Real instrument blocked the virtual instrument from the user so I had to make an offset that placed the virtual instrument next to the user's real one.

Conclusion

Virtual/augmented reality is a viable option in instructing music. It lets the user interact with their real instrument while taking cues and direction from a virtual one. The CAVE 2 did a good job at tracking the user's instrument and creating a more immersive environment while the HoloLens was a more portable solution that did a better job instructing because the virtual instrument is overlaid on the real one so the user can see both without moving their eyes much.

The End

Questions?