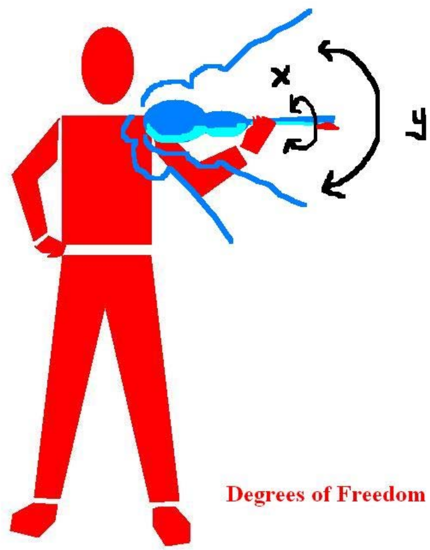
Team Passive Aggressive's Violincellerometer with Attitude

Laura Yue Bai, Jennifer Jody Chen, Stuart Anderson, Amy Seymour

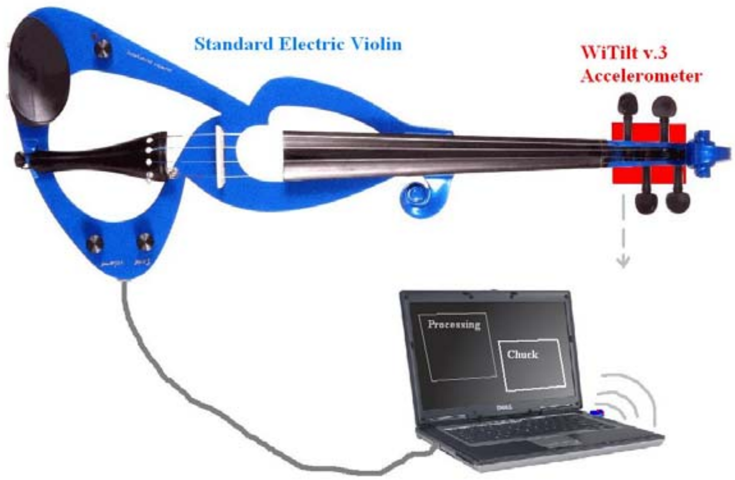


<u>Description:</u>

The Violincellerometer with Attitude is a compositional reinvention of the standard electric violin that takes advantage of the human elements of performance to better inform the tonal quality of the music produced. By incorporating an accelerometer into the functional body of the instrument, the Violincellerometer is able to integrate user movement, translating intention – in the form of both conscious and unconscious movement – on the part of the performer into mappings to various effects and modes. The most significant aspect of the violin-accelerometer integration is the absence of buttons or physical switches; instead, by mapping only the "natural" gestures of violin-playing to sound, the user is presented with a much more intuitive interface.

<u>Motivation:</u>

Most violinists, to varying extents, move around slightly while playing the violin. Some violinists move more when the music gets more intense. It would be fun to harness the potential of user movement and use it to control different aspects of playing (as opposed to using foot pedals, etc.). Also, the Violincellerometer could be used as a compositional aid to emphasize or de-emphasize certain musical intonations as desired by the user.



Equipment:

- Musician Novice Electric Violin (VLN-E10-Blue) - $100
- accelerometer (Tri-Ax Bluetooth WiTilt)
- sound card with microphone in
- bluetooth adapter
- miscellaneous cables
- software: Processing (w/OSC), ChucK, Mac OSX

Design:

-Violin

The main frame of the violin has not been altered. A shoulder rest is strapped to the base in the standard position. The accelerometer has been attached to the topmost scroll (where the pegs are) in order to interfere as little as possible with the actual playing of the violin and so that it would register a larger range of values due to the greater freedom of movement at this point.

-Accelerometer:

A WiTilt v.3 accelerometer is secured flat to the scroll of the violin, in the direction with the axis running from the tailpiece up to the neck. The WiTilt sensor will be positioned such that Z is elevation, X corresponds to theta and Y corresponds to the radial direction (in terms of polar coordinates). We are using the WiTilt "Degree mode", which detects X and Y axis directional rotation, because experimentation suggests that this type of movement is most representative of the natural class of violin-playing gestures for most users. The acceleration and tilt will be used to control different sound effects (distortion and echoes, reverb, delay, and playback).

-Software filtering:

Processing acts as a pipe to ChucK which then samples the signal received and adds filters and effects. All values are cast to Integers. Due to physical constraints, there are three primary issues: the WiTilt sensor cannot be attached completely along the axis of the violins, users are unlikely to assume a single "ideal" position when playing the violin, and the WiTilt data itself is noisy and fluctuates. To resolve each of these problems, we implemented the following solutions: we calibrated the sensor to respond correctly to rotation position; we tested and tuned the ranges of values for specific effects to allow for imprecision in player position; and we sampled less data and averaged the samples to smooth the sound inputs.

Process:

Our design and coding is separated into 3 distinct steps:

1) Reading in sensor data from the WiTilt Sensor
   - Read from Processing
   - Processing forwards to ChucK through OSC
2) Reading in electric violin output; actual music being played
   - Standard audio-out/ microphone-in
3) Processing both sets of data (sensor and sound) on the computer
   - Use ChucK to process the data on the fly, for real-time, concurrent musical intake, analysis, and manipulation

Team Tasks:

-Laura: Connect WiTilt Tri-Ax sensor via Bluetooth serial to Processing; connect Processing to ChucK via the OSC interface

-Jen: Program ChucK to receive Processing signals via OSC, program ChucK filters such as echo, reverb, playback

-Stu: Develop prototype and sensor positioning designs by experimenting with various positions for various 'states' of instrumental playing

-Amy: Program logical states into ChucK to partition state spaces around user

Testing:

Procedure:

One of our group, Stu, who has had experience in violin performance, engaged in preliminary testing of the Violincellerometer by performing in front of the team, who would then give constructive criticism. Stu analyzed the playability of the instrument from the performer's perspective, while the rest of the team commented on the quality of performance from the audience's perspective.

Because we recognize that Stu has had more time to familiarize himself with the operation of the instrument and would therefore bias the assessment, we also tested the Violincellerometer with another proficient violinist at Princeton. This volunteer assessed the playability of the instrument, the steepness of the learning curve, if it was intuitive, if there was anything they would like to change (would they prefer buttons for switching modes), whether mode switching physical positions interfered with their playing, if the accelerometer's physical position on the scroll interfered their playing, and whether they found it enjoyable (scale of 1 to 7 with 7 being the best). They played the violin without the accelerometer, as a control, so that they could comment on whether they preferred the electric violin without effects or our enhanced version.

Results:

All of the reports we looked at didn't really have much in the way of quantitative data, and overall, our study is more qualitative than quantitative.

Stu's Performance:

Stu very much enjoyed the violin (7 out of 7). He preferred changing modes or effects on the fly, as opposed to using buttons or a pedal. Buttons would be useful if they changed to other modes that made additional effects possible. It was more fun than playing the electric violin without effects – a cheap electric violin, in this case, seems to sound better with effects than without them. It was interesting to find that almost all of the same playing techniques could be used on the electric violin that can be used on an acoustic violin. He really liked guitar mode. It would be nice to have the option to choose between forward/backward for effects, as opposed to side-to-side effects. The violin probably needs to be calibrated for each performer, since we hold the violin slightly differently. The WiTilt is in a good place, but makes the tuning slightly more difficult.

Volunteer's Experience:

Rebecca rated the violin's performance at 5 (on a scale from 1 to 7). She also liked using movement to control tonal quality over possibly using buttons, because of the ease in transitions between different effects on the fly. She thought it was strange that you had to stay in a relative position to keep from changing effects, which could prevent some people from being able to move about as freely as they might like while playing. If the violin were calibrated specifically for her, it might be a little better (we were able to improve her control a bit). She says it would be good for non-classical performances, but not as good for something like Beethoven (as compared to an acoustic). She didn't like the position of the WiTilt because it limited tuning ability. She liked the idea of forward/backward effects, but felt that shifting (left-hand) positions could inadvertently cause effects changes. She thinks that it would be cool to have a mode where you can make gradual effects changes – the more you lean, the more effects you get (more intense, longer delay, etc), but only if you can pick if it is in a continuous mode or a on/off binary mode. She agrees that the strings are bad, and if replaced with better strings would improve the experience. She does not think the guitar mode is very useful.

In the future, it would be better to have more test subjects and more input. We would be able to compare calibrations to look for similarities. Given our time constraints and peoples' lack of availability near Dean's Date, we weren't able to get as many test subjects as we had hoped.

Conclusion:

The work done so far represents only a fragment of what the Violincellerometer is capable of. In fact, there are many more mappings that can be adapted and represented intuitively by the WiTilt/ChucK complex. Also, devices that previously used buttons to switch between modes can now use the mechanism of state spaces around the user to switch – this can be especially useful in cases where rapid or fluid shifts are required. Users that would prefer to have fun with altering the tone of their instrumental device without putting in too much extra thought can use the Violincellerometer for a quick and easy addition to their compositions. In our testing, we also found that users would find adding buttons more difficult and that the mappings were appropriate.

The Violincellerometer represents a good preliminary design for mapping motion to sound. Previous designs we looked at, such as the Hyperbow, modified other aspects of the violin, and this is the first example that we found of trying to map sounds to the movements of the violin's body. The Violincellerometer is a good stepping stone that could be easily extended to even more mappings with even more sound manipulations. It could use further improvements to control for noise and add more mappings, but the framework is there. We believe that the future of the Violincellerometer, if pursued, is bright due to the enthusiasm of the musicians we encountered. Even with the limited number of mappings, they found it interesting and promising, especially for non-classical performances. We find the idea of the Violincellerometer as a practice device, using the echo function to replay the previous notes to check for intonation, is especially interesting and see this as an example of the many different uses there could be for an augmented instrument. The Violincellerometer is an example of what can happen when sound and motion are mapped together, and the result is fascinating.

Future Work:

There are potential issues with noise from finger movement, position changes, bow changes/strokes, and vibrato. We could use a bow with position, accelerometer, and strain gauges, similar to the one created by Diana Young to be able to run experiments observing bow usage. With such a device, we could monitor bow activity in real time, and have a corresponding noise-removal filter/algorithm based on trial and error from the added vibrations and movements caused by bow activity. Also, similar work could be done measuring forces of the left hand on violin playing, to further augment noise filtering algorithms.

We would be interested also in adding more mappings once we had better noise control. We would like to add recording and playback functionality, but in order to achieve this successful, we would need to be very careful about noise control and accidentally triggering.

We would also like to add some sort of feedback to changing modes, preferably force feedback since audio feedback would interfere with the music being produced. With force feedback, the musician would be able to “feel” the different areas instead of relying on muscle memory. This could allow musicians to operate more precisely and possibly learn mappings more quickly.

We are also interested in adding a calibration mechanism, since through our testing, we found that different sized violinists would be more comfortable playing at different angles. Taller violinists would have a larger “normal” range that a shorter violinist’s “back leaning” mapping would be within. A calibration mechanism could allow different violinists to set the mappings that they would be comfortable with.

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