ES93 FINAL PROJECT REPORT
THE LAZER BASS
Peter Edwards

Who

Our group consisted of myself, Anit Das, Andrew Kim and Nate TC. At the beginning of the year we split up the work into assignments for each of us, based on our strengths and areas of study. Andrew was in charge of the wiring, Nate the woodworking and instrument design, Anit and I the programming in Max and Reason.

Goals

We started out with loads of obviously unobtainable goals – we wanted the instrument to collapse into a violin and for the lasers to also read bowing motion, to expand into a cello or double bass and to retune itself to each instrument automatically, for example. We finally just agreed that we wanted to create a bass guitar that played smoothly and offered players a couple of expressive controllers not found on regular basses.

General Design

The physical layout of our instrument is as follows: a ribbon controller gives data to an arithmetic function upon the bass intervals of four laser / photocell pairs, which trigger open strings. The uppermost region of the ribbon controller changes the filter resonance of the sound, and a single-axis accelerometer on the back of the neck changes the LFO rate. Two FSRs on the body change LFO amount and Wet/Dry Mix on a reverb module.

First Deadline

By the first deadline our group had finished most of the body of the instrument, having only to attach strap buttons, replace a laser and put a back on the body. The Max patch had a functioning note-making mechanism, which we had tested only with bangs and sliders, and four Reason controllers set up for changing the filter resonance of the bass, adding distortion and reverb and adjusting the LFO rate and amount. The wiring was nowhere near finished. By the demo time we only had the ribbon controller (bass guitar neck) wired up and it was not giving linear data nor did Anit and I have time to configure it properly in Max.

Process

The first step past our first, rather unsuccessful demo was to accomplish all of the wiring. This took the majority of the time we spent on the instrument so, even before Anit and I could configure all the sensors on the instrument, we began experimenting with the ribbon as a momentary pitchbend controller. Nate mounted the MIDItron onto the underside (soon to be inside) of the instrument and made a back for it. When Andrew had finished the wiring and Anit and I had tested it and made sure everything was responding the way we wanted it to, Nate encased the wires and breadboard inside the instrument by attaching he back and Anit and I configured and scaled all of the incoming data into the patcher so that the instrument was playable.

Instrument Body

The instrument is patterned after a bass guitar with a neck from a small acoustic guitar and a hand-made body. It is even complete with strap buttons and a strap. The main difference between our instrument and its acoustic counterpart is the orientation of the strings – our lasers went down to up when you held the instrument like a bass, as opposed to coming down from the neck like strings would have. This choice was for playability, namely addressing the threat of constantly tripping multiple wires unintentionally.

Electronics

Originally hoping to wire the entire thing onto per board and have the system encased in the instrument, Andrew's wiring was the most time-consuming aspect of the project. He eventually decided to wire it on breadboard since he had to start over to locate a short and prevent cross talk anyways. We encountered issues with the MIDItron as well until Jon told us that there is an order one has to configure things in on the MIDItron Programmer. Eventually, Andrew got all the sensors working save two of the FSRs, unable to figure out the cross talk the last two FSRs were making with so little time left before our due date. By experimenting with resistors he was able to make the ribbon respond as linearly as possible, though it still had some bugs to fix in the patch. The accelerometer, lasers and photocells all worked flawlessly.

Nate and Andrew then mounted the MIDItron onto the instrument and encased all the wiring with the back of the body.

Max Patch

After the wiring, Anit and I discovered just how much work had yet to be done in Max to finish the instrument. We set our note-making mechanism to read the photo resistors, triggering a bang to the makenote whenever an interrupted beam was again allowed to pass to the sensor – we did it this way so notes would only sound after plucking a string, not by resting on it. We tried to make a mechanism for controlling the note-duration by holding one's finger in the beam for however long you wish to sustain a note. However, this mechanism required the photocells to be analog sensors, which they proved to not function very controllably as.

We spent the bulk of our time after the wiring was done configuring our ribbon. Our pitch-bend mechanism, set up to allow slides, hammerons and pulloffs, had to be retired for it only messed up the notes being selected. We did not have the time to figure out a functioning design for it. We scaled each region of the ribbon (on the neck) so that each region played 7 or 8 distinct notes. This made the ribbon quite playable despite its bizarrely non-linear response. Each ribbon defaulted to the lowest value of its region, so we had to come up with a simple system to filter out those notes and have every released ribbon read at zero (open string).

In addition, we configured the two FSRs we were working with to control LFO amount (with the accelerometer controlling rate) and reverb wet/dry mix. We had set up more effects in Reason and Max but no longer had the sensors to accommodate all of them.

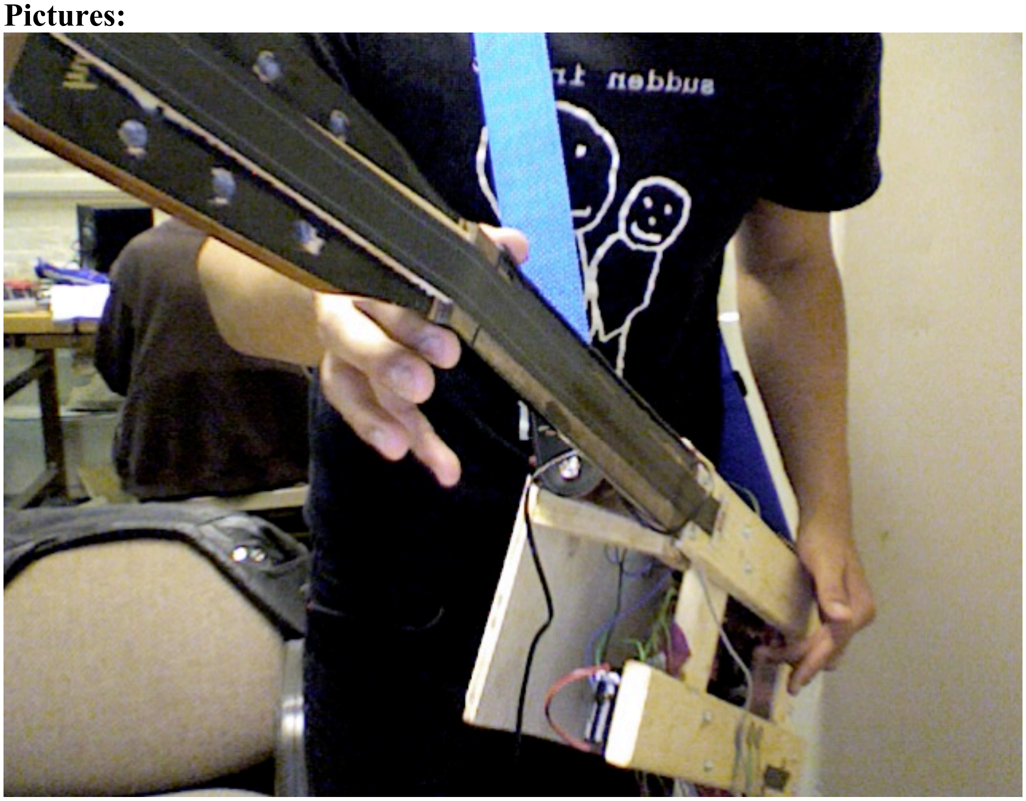
Finally, we had constructed a separate patcher that took data from the main patcher from sends and receives and had parameters like note number, reverb amount, distortion, etc. control different sliders and buttons. In presentation mode, this was meant to be our instrument's GUI and monitor.

Reason

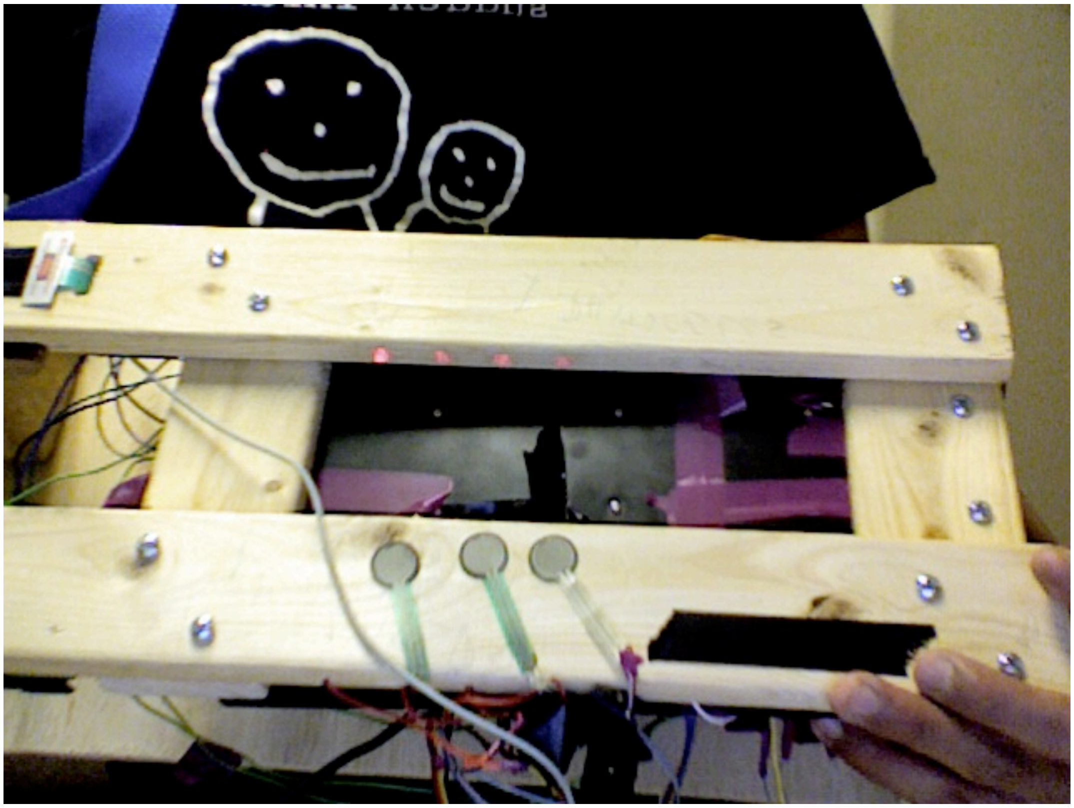
Our reason patch was simple with a Subtractor, Scream 4 distortion and an RV7000 Advanced Reverb. FSRs controlled the Dry/Wet mix on the reverb module, the LFO amount right on the Subtractor module, and were intended to turn the distortion unit from bypass to on and vice versa. The accelerometer changed the LFO rate, also right on the Subtractor module.

In the end, while we never accomplished some of the extra features we wanted to add to our original design, the instrument played fairly intuitively and smoothly, had zero bugs and incorporated a lot of expressive control.

Pictures:

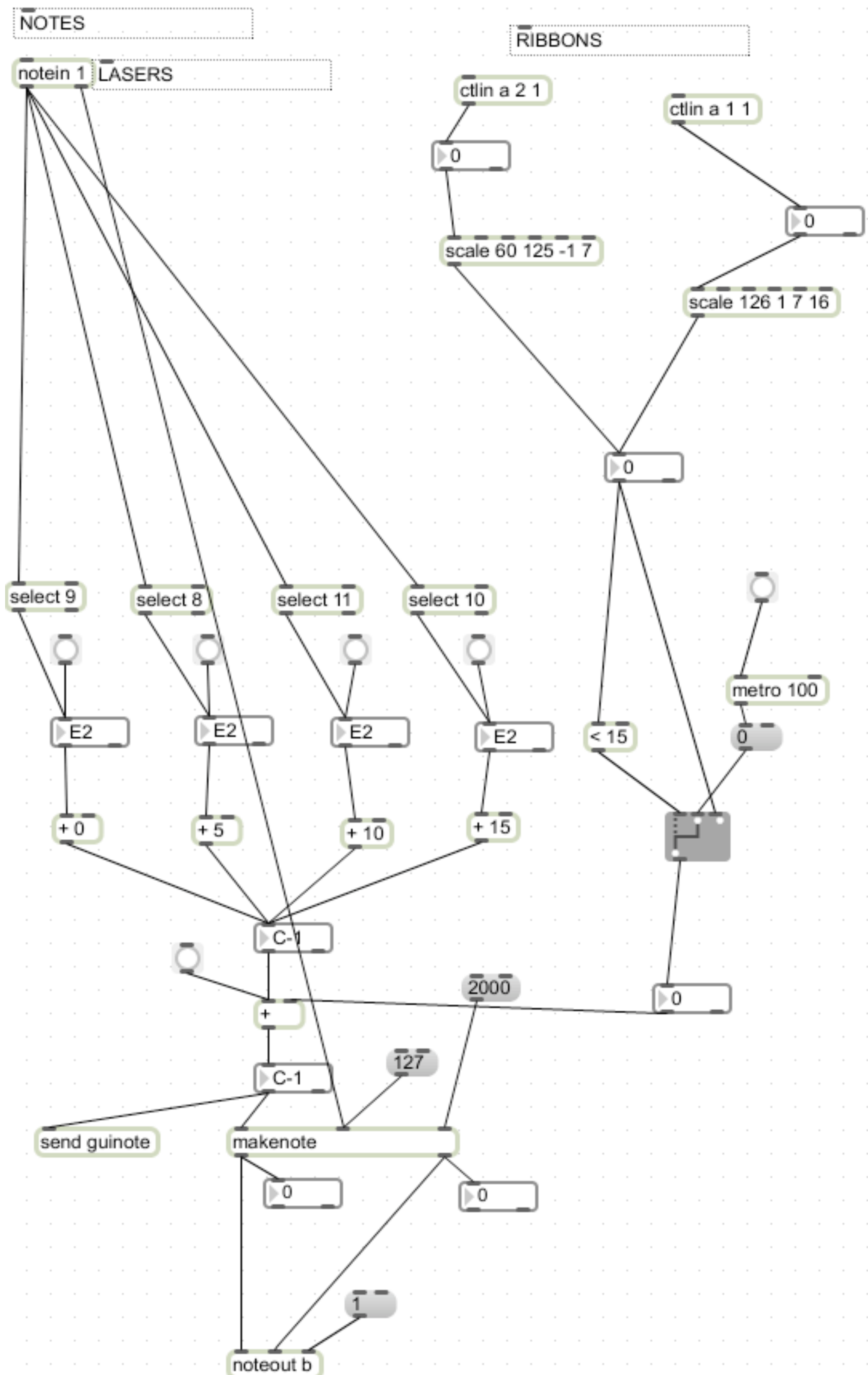


The instrument

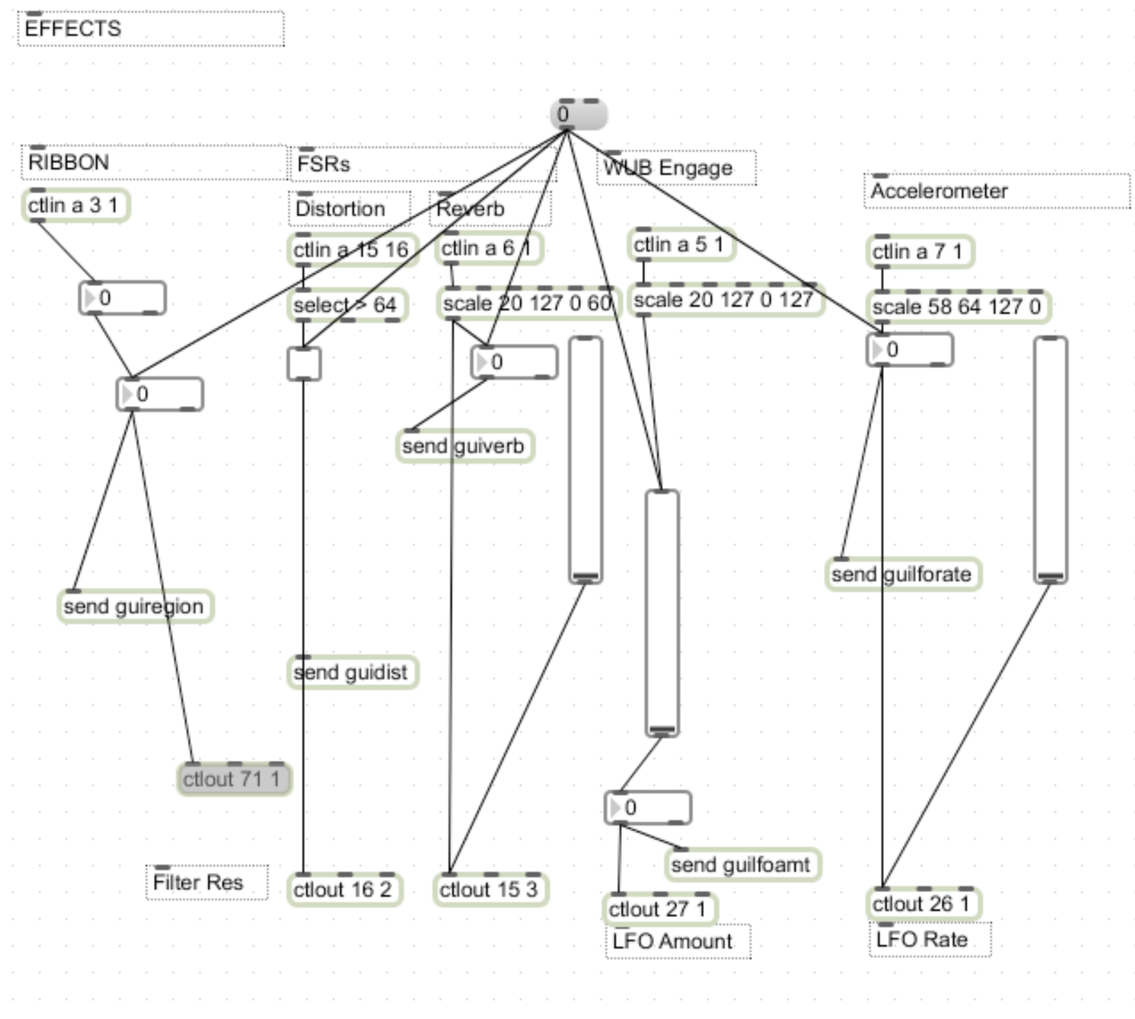


Close up on the lasers / photocells on the body.

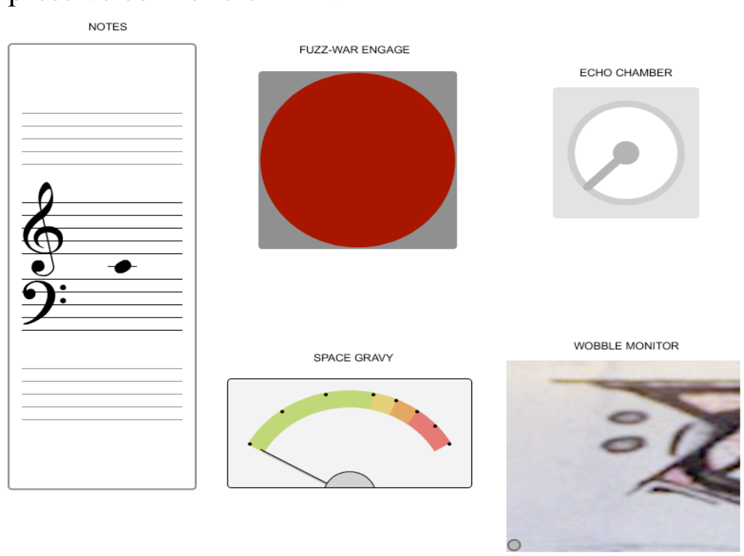
Reason Patch



Note Making Mechanism in Max



Expressive controllers in Max



GUI (Graphical User Interface) Subpatcher in Max, in presentation mode.