

# 21M.370 Digital Instrument Design

## Lab assignment 6 - Due March 31 at 2:00pm

### **Deliverables:**

1. A 1-page description of the mappings you created.
  2. A link to a 1-2m video of you performing with an instrument based on Chester
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### **Assignment description:**

This week we will be building an instrument which uses an IMU as one of its primary inputs. The basic instrument is called Chester, and build instructions, ESP32 firmware, python scripts, and PD patches are provided for the Chester instrument.

But in addition to just building Chester you are also required to modify the mapping in at least two ways.

First, you should use the IMU data to control one additional synthesizer parameter. You can use any of the existing IMU signals (raw/smoothed/ magnitude of accelerometer, raw gyroscope, tilt, velocity, jerk, velocity magnitude) or create your own IMU signal. Some good targets for mapping IMU data:

- use jerk to trigger a burst of reverb
- control the waveshape of BWL-OSC 2, 3, and 4. (The waveform of BWL-OSC 1 is different and responds to waveshape in a very different manner).
- Change the REVERB time of the two reverbs
- Change the pitch glide time
- Add additional modules (oscillators, effects, etc.) and control those.

Second, you should map the encoder to control at least one parameter. In the mapping tutorial I show how to use it to control the master volume, and also the smoothing for the magnitude value - and you can follow that example, or use the encoder in a different way. Using the encoder to change smoothing or scaling for input signals is a great way to be able to tweak the feel of your instrument on the fly.

For this lab, you should write a short description of the mappings you chose to create, and submit it with your video link - as well as being prepared to discuss your mapping in class.

## Assignment goals

1. Assemble 4 lever switches, 1 encoder, and the IMU module.
2. Test the IMU module with your ESP32 breakout board, and when you have confirmed it is working solder it directly to the breakout PCB.
3. Connect the switches to p6-p9, the encoder switch to p10, and the encoder A and B to p12 and p13. DON'T USE p11 for the encoder! Due to a quirk of the ESP32 it won't work in this instance.
4. Assemble Chester, either following my example or creating your own vision.
5. Play with the provided python script and PD patches to learn the instrument.
6. Decide how you might add an additional IMU control as well as how you will use the encoder. Implement these in your python script following the mapping video example.
7. Record a 1-2m video of yourself playing your instrument.
8. Write a short description of your mapping and be prepared to share with the class.

## Video tutorials

1. [Soldering the sensors](#)
2. [Assembling Chester](#)
3. [Testing the sensors in firmware](#)
4. [Overview of working with IMUs](#)
5. [Mapping tutorial](#)
6. [Chester demo video](#)
7. [Chester overview](#)

## Links:

[IMU overview notes from class video](#)

[Accelerometer and Gyro guide by Sparkfun](#)

[Practical Guide to Kalman filters for sensor fusion](#)

## Notes on Chester build:

1. Make sure the lever switches are attached to pins 6-9
2. Make sure the encoder switch is on pin 10, and the encoder A and B pins are on pins 12 and 13. You should not use pin 11 for this project.
3. You can follow the same design as I created for chester ( a handheld instrument built with a cardboard frame) or make your own in any shape you would like. Obviously, you need to make something that will allow you to use lots of motion!
4. When attaching the PCB to the cardboard frame, be sure to use standoffs as in the pictures below, which is slightly different from how I did it in the video. You should use at least three standoffs so the board is rigidly attached to the frame.
5. No Wifi yet, so try and use a long micro-USB cable.



