

Product Design Specification Team #5

- **Executive Summary / Concept of Operations**

This device is intended for hobbyists and musicians, particularly using digital instruments run from a laptop. It is a MIDI controller, much like a digital piano keyboard. Just like any other MIDI controller, the user can easily set each control surface (or sensor) to control any parameter in a DAW (digital audio workstation) on their computer.

- **Brief Market Analysis**

This product is intended for anyone using a computer and digital instruments to make music. There are a lot of devices out there that do this, but what makes this different is that it's wearable design makes playing an instrument more about movement. The MiMU gloves, developed by Imogen Heap, are similar to the intention of this device, yet were designed to manipulate live recorded audio (such as voice), versus our design which is intended for live digital instruments. Having controls literally at the tips of your fingers is easier than constantly adjusting settings on a computer screen. A prototype of this device could end up costing over \$100, but with further development that price could be dropped well below what similar products cost currently.

- **Requirements**

- Must be wearable
- Must translate hand movements to MIDI events, should be able to emulate tremolo and/or vibrato effects using hand movements
- Should be able to play notes like an instrument while using the other hand for effects
- Must connect to a computer via USB, should be powered by USB
- Must use at least 3 different types of sensors
- Must translate digital and analog inputs into MIDI
- Must be compatible with existing MIDI software to appear as a MIDI instrument on an external computer
- Should have LEDs that may activate in response to individual sensor input

- **System Architecture**

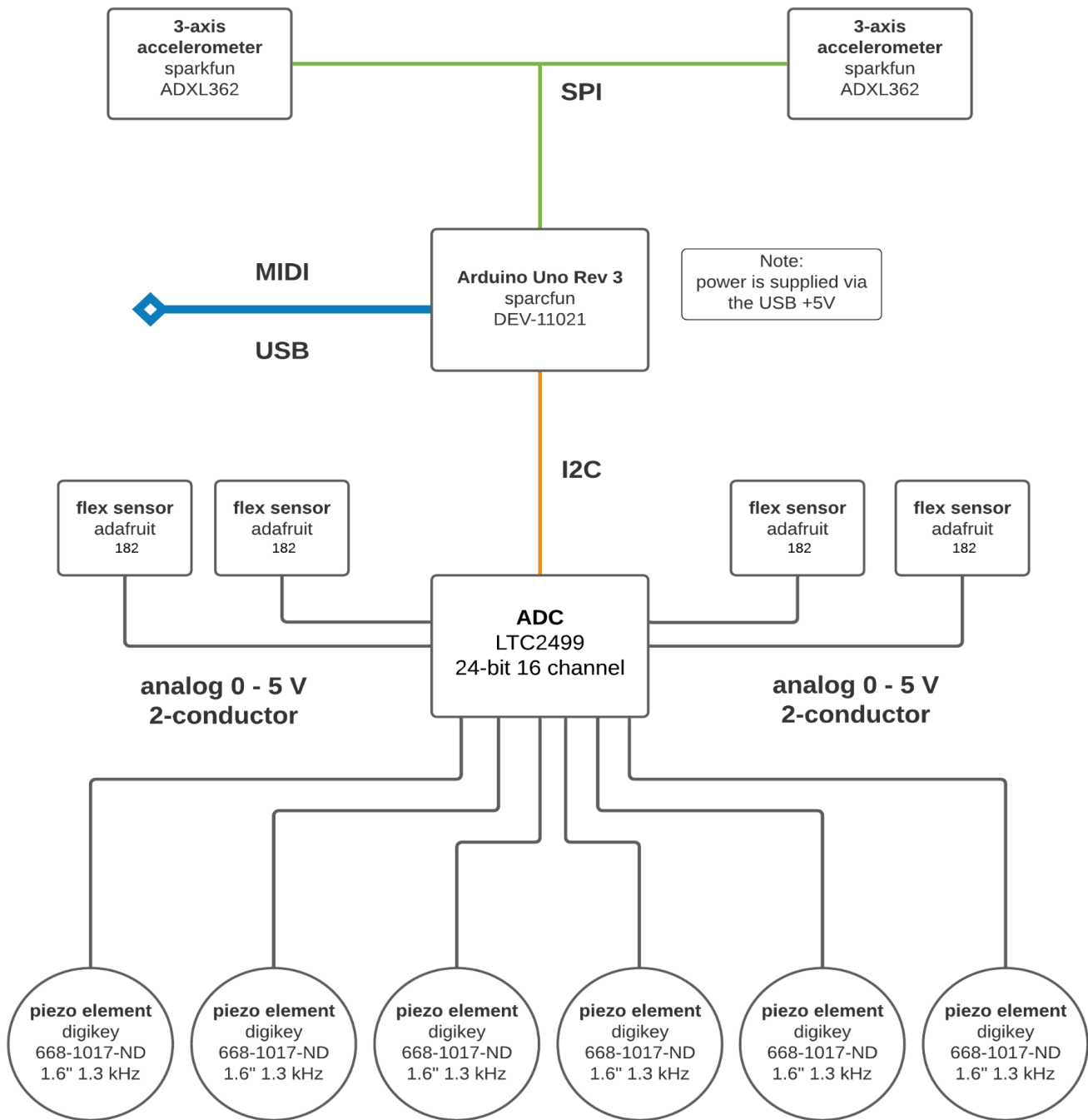


Figure 1: Level 1 Block diagram

- **Design Specification**

- **Processor: Arduino Uno**

- ADC LTC2499

- Analog to digital converter. Since Arduino does not have multiple interfaces that can support 4 flexible sensors and 6 piezoelectric element interfaces at the same time, it is necessary to use ADC to combine sensor data and then transmit to Arduino through I2C. Power is to be supplied via the USB +5V DC connection from the host.

- **Sensors:**

- 2 3-axis accelerometers (sparkfun ADXL362)

- The three-axis accelerometer will be connected to the back of the hand to sense the acceleration generated by the device (for example, wave a hand), and then send a digital output to the arduino

- 4 flex sensors (adafruit 182)

- The flexible sensor will be attached to the index finger and middle finger of the device to sense the bending motion and generate music corresponding to the motion. Each hand will use two.

- 6 piezo sensors

- The six small piezo elements have a range of voltage response that can be translated to digital through the ADC so that they act similarly to keys on a digital piano, or regular midi control pad.

- **Actuator:**

- Digital and analog signals sent from sensors are translated by the ADC and processor into MIDI signals sent via USB to a computer which turns MIDI signals into analog audio output.

- **Connect:**

- I2C Used to connect ADC and Arduino

- SPI Used for wiring between the accelerometers and Arduino

- Analog signals over 2-conductor in the range of 0-5V between the piezo elements and the ADC

- USB Used to connect Arduino Uno and computer, with MIDI used as the application protocol

- No moving parts

- Will use preloaded bootloader on AVR chip and Arduino IDE