M.I.D.I.

NLN HackLab

`https://github.com/RobBothof/nln-hacklab-classes`

M.I.D.I.

PLANNING

- Midi fundamentals
- Building a basic midi controller: (1 button - 1 fader/knob)

  - Controller overview
  - Building hardware / Soldering
  - Programming the midi device
  - Connecting to the ‘puredata’ software and making some noise

MIDI Fundamentals

(Musical Instrument Digital Interface)

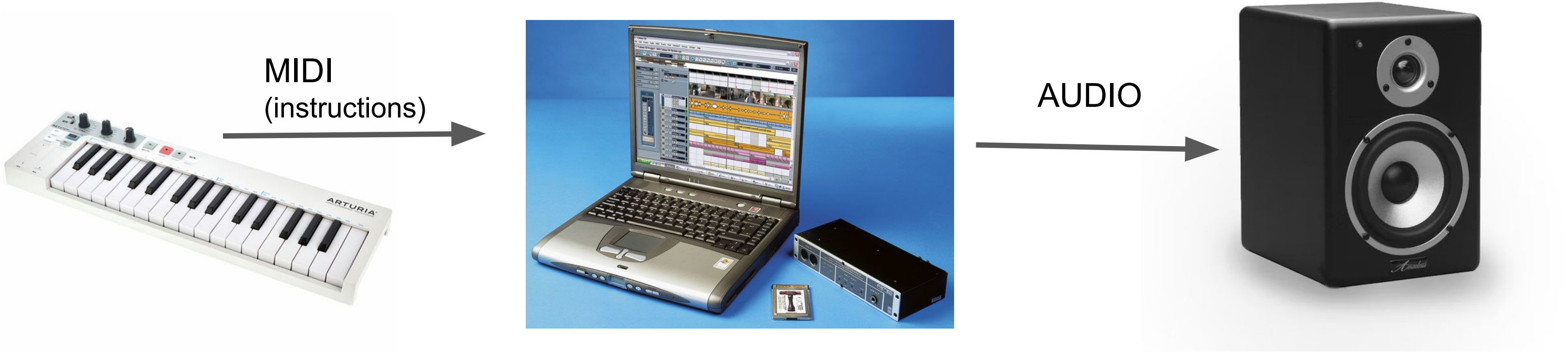
A Digital Protocol and Technical Standard to communicate between ‘audio related’ devices and/or software programs. Developed around 1981/1982 through a collaborative effort of synthesizer manufacturers.

MIDI can not be used to send audio!

It consists only of control instructions.

M.I.D.I.

Fundamentals



MIDI Controller

MIDI
(instructions)

Computer

AUDIO

Speaker / Amplifier

Sends what notes to play.

Generates audio with software based on received Midi notes from controller.

Creates audible sound from audio signal

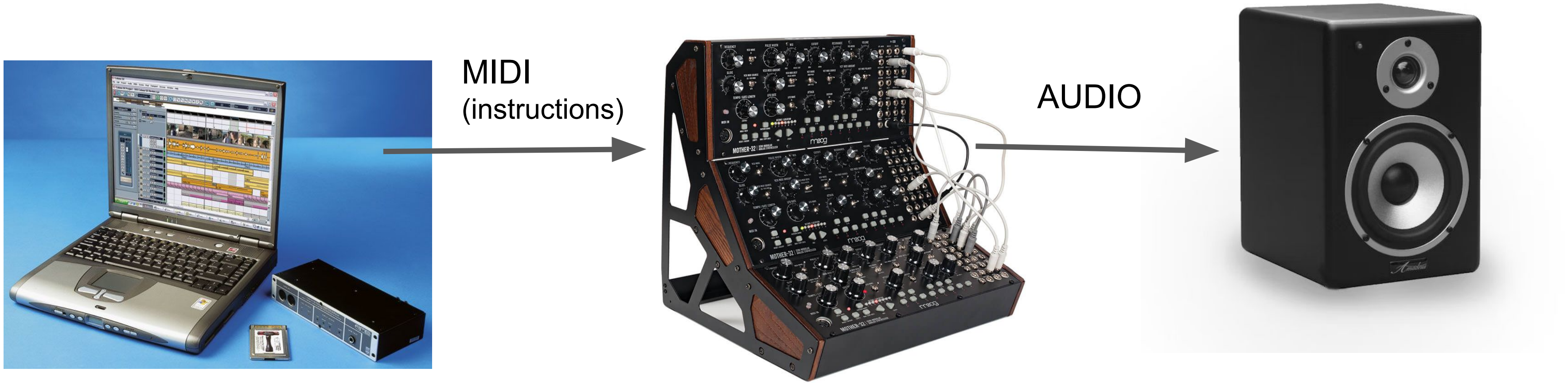
M.I.D.I.

Fundamentals

Computer
(functioning as midi controller)

Music Instrument
(e.g. synthesizer)

Speaker / Amplifier



MIDI
(instructions)

AUDIO

Sends what notes to play and what tonal setting to change.

Generates audio with hardware based on received Midi notes from computer.

Creates audible sound from audio signal

M.I.D.I. Fundamentals

MIDI Controller

MIDI
(instructions)

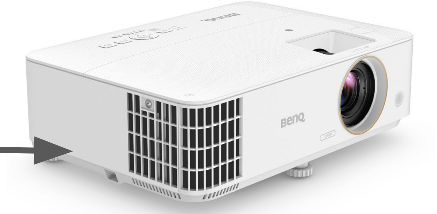
Tells the computer what clips to play / effects to use.

Computer
(running VJ software)

Generates video with software based on received Midi instructions from controller

Video

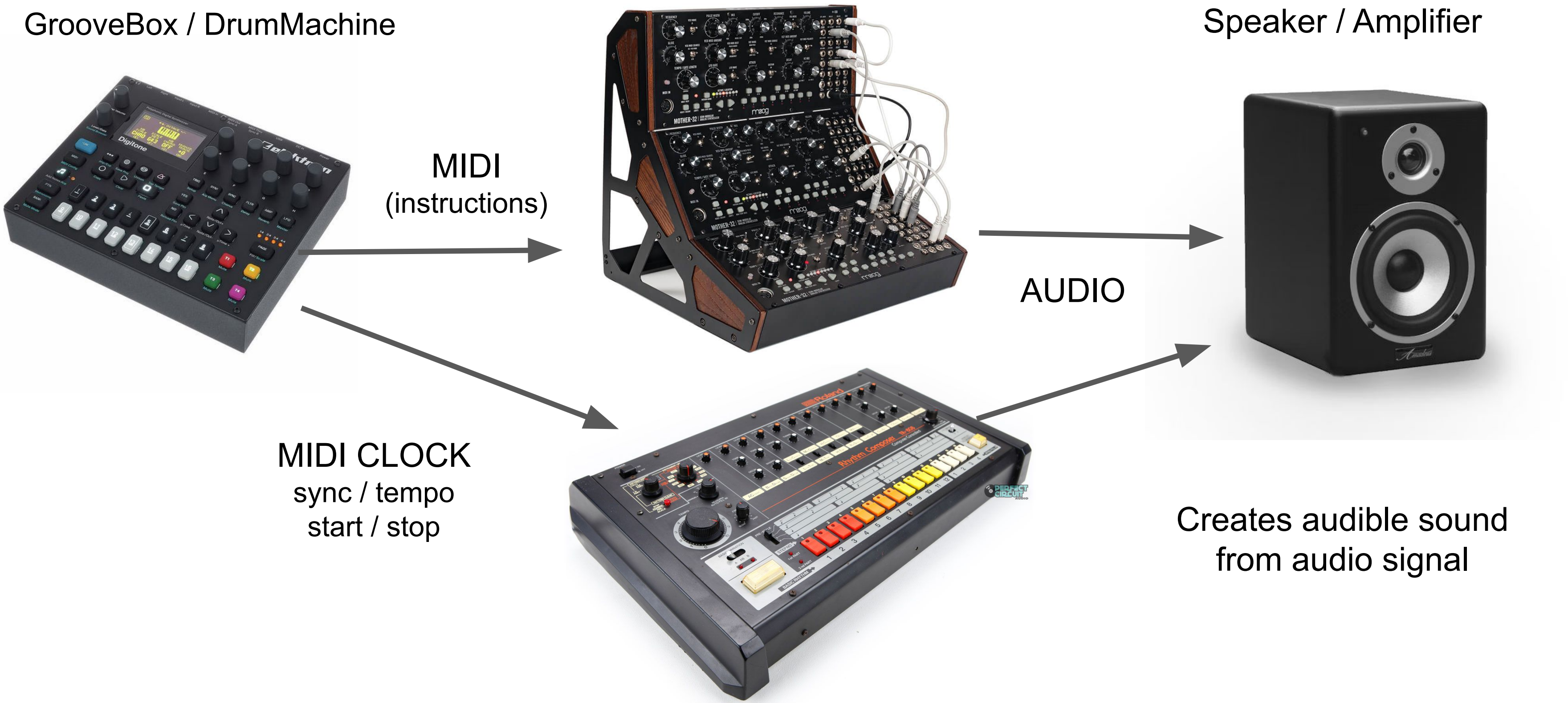
Projector



Creates Image / Video Installation

M.I.D.I.

Fundamentals



Music Instrument
(e.g. synthesizer)

GrooveBox / DrumMachine

MIDI
(instructions)

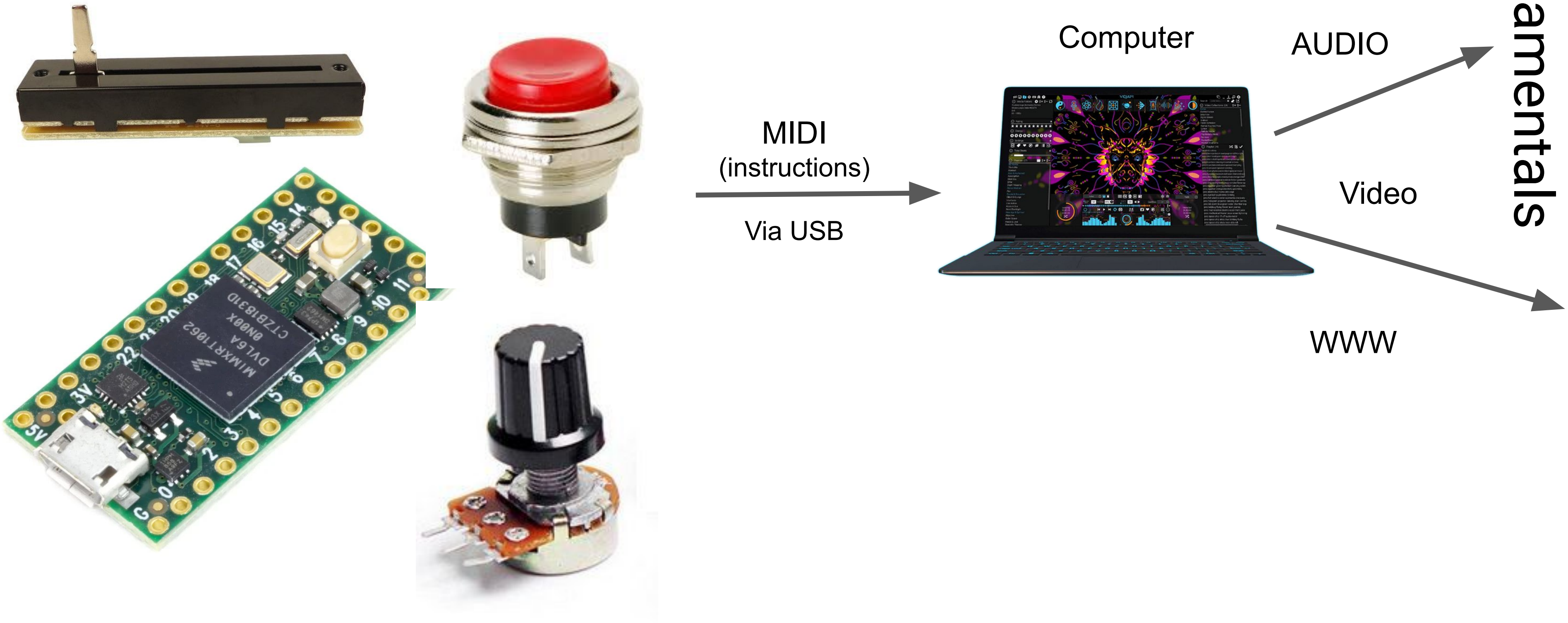
Speaker / Amplifier

AUDIO

MIDI CLOCK
sync / tempo
start / stop

Creates audible sound
from audio signal

M.I.D.I. Fundamentals



Our own custom MIDI Controller

MIDI (instructions)

Via USB

Computer

AUDIO

Video

WWW

MIDI Advantages

- Wide support in Music instruments, controllers, software programs (even web browsers)
- Simple serial protocol (doesn’t use much data)
- Connect via usb, or 5pin cable between other devices
- Don’t need to install drivers, support is build in OS.
- Can also be stored as a midi-file. Which can contain an entire orchestral score digitally.

One of the easiest ways to interface with other devices. Allows us to control computers in a different (more playful) way and approach devices as real instruments.

MIDI Disadvantages

- Low resolution (7 bits) means values go from 0 - 127 steps
- Could be faster (especially using usb)
- Predefined controls signals can be too limited to fully express the characteristics of a sound.

M.I.D.I.

Fundamentals

Essential Instructions (MIDI Messages)

- **Note On, Note Off** messages

[Note Pitch]	(which key on the piano keyboard - pitch 60 = C4)	0 - 127	
[Note velocity]	(strength or force for that note)	0 - 127	(Note off = 0)
[Midi Channel]	(Channel is used to talk to multiple instruments	0 - 16	

- **Control Change** messages

[Control Function]	(e.g. 7 = change volume, 10 panning left/right)	0 - 127
[Control Value]	(amount for this function e.g. set volume to 80)	0 - 127
[Midi Channel]	(Channel is used to talk to multiple instruments	0 - 16

Others MIDI messages

- Program Change, pitch bend, aftertouch (key pressure)
- Clock, Transport (play, start, pause etc)
- Sysex - raw data (e.g. used to transfer user presets etc)

MIDI Messages

Unless we want to control a specific instrument (e.g. a Moog synthesizer, or Drum machine in Software program like Ableton) We can freely use these Note and Control Messages ourselves as we see fit within our own designs, and most software allows us to Map Note and Control Messages to various functions.

Although it is originally designed to control the synthesizer instrument, the protocol is often [hacked] to serve other purposes because of its wide support in hardware and software.

For example

- A Note-On is used to trigger a videoclip in a VJ program.
- Control Messages can be assigned to mix two tracks in a DJ program.
- A Note-On / Note-Off is often accepted in return by midi controllers to turn lights of buttons on and off.

Official Manufacturers of Instruments and devices (should) publish their implementation as their ‘Midi Specification’ which you can you look up if you want to control a specific instrument (but they do not always give you all of the specs).

[DEMO TIME]

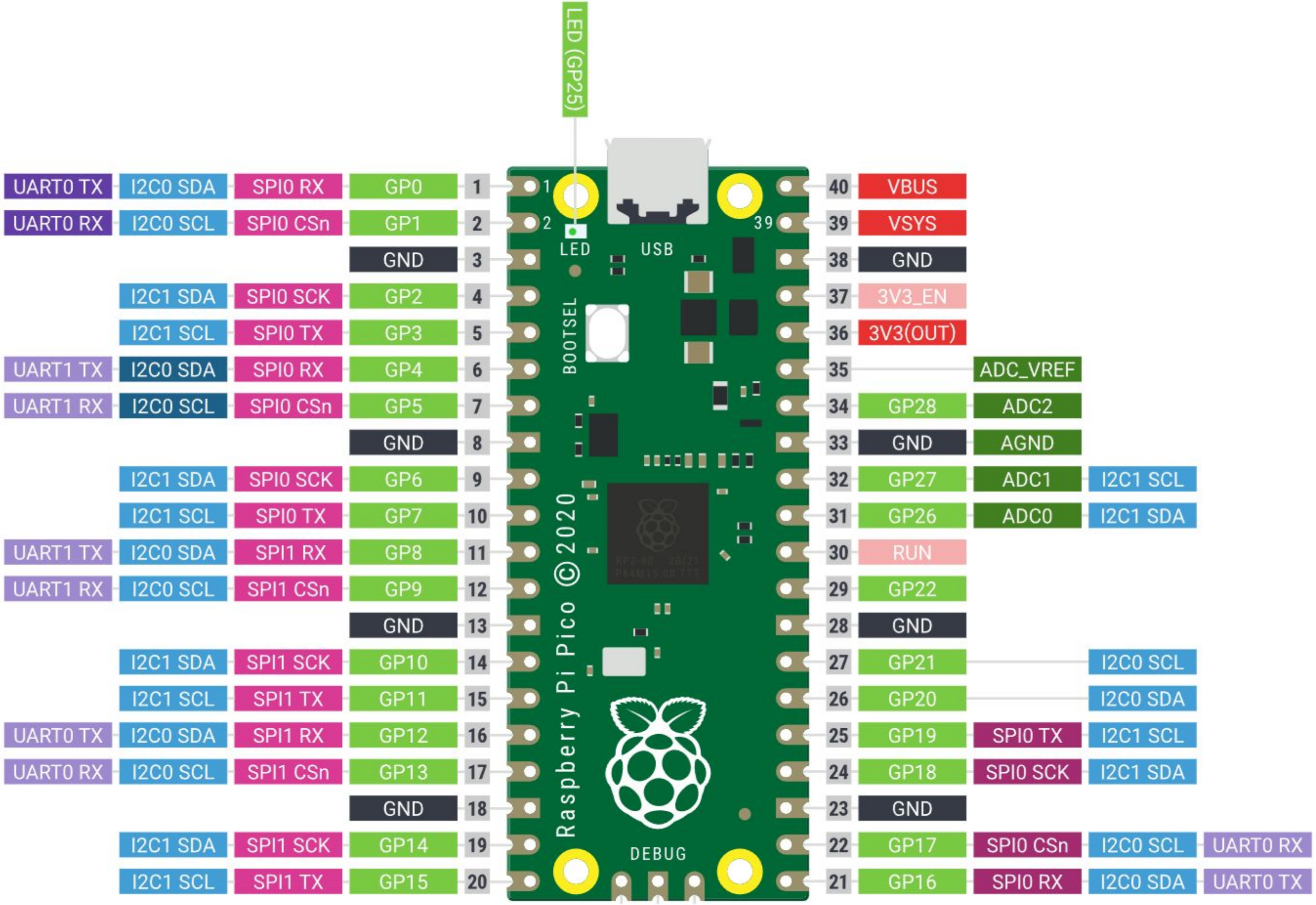
Building the super basic midi controller

1 button and 1 fader (or rotary potmeter)

As a starting point for your own designs.

M.I.D.I.

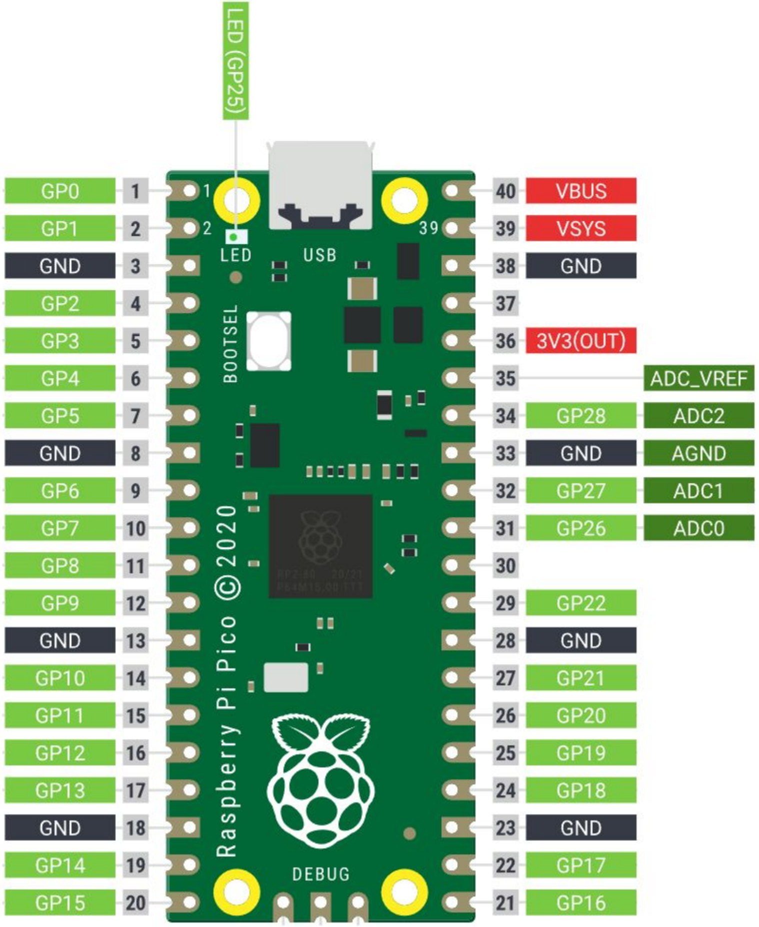
Building basic midi controller



- 🟥 Power
- ⬛ Ground
- UART / UART (default)
- 🟩 GPIO, PIO, and PWM
- 🟩 ADC
- SPI / SPI (default)
- I2C / I2C (default)
- System Control
- 🟧 Debugging

M.I.D.I.

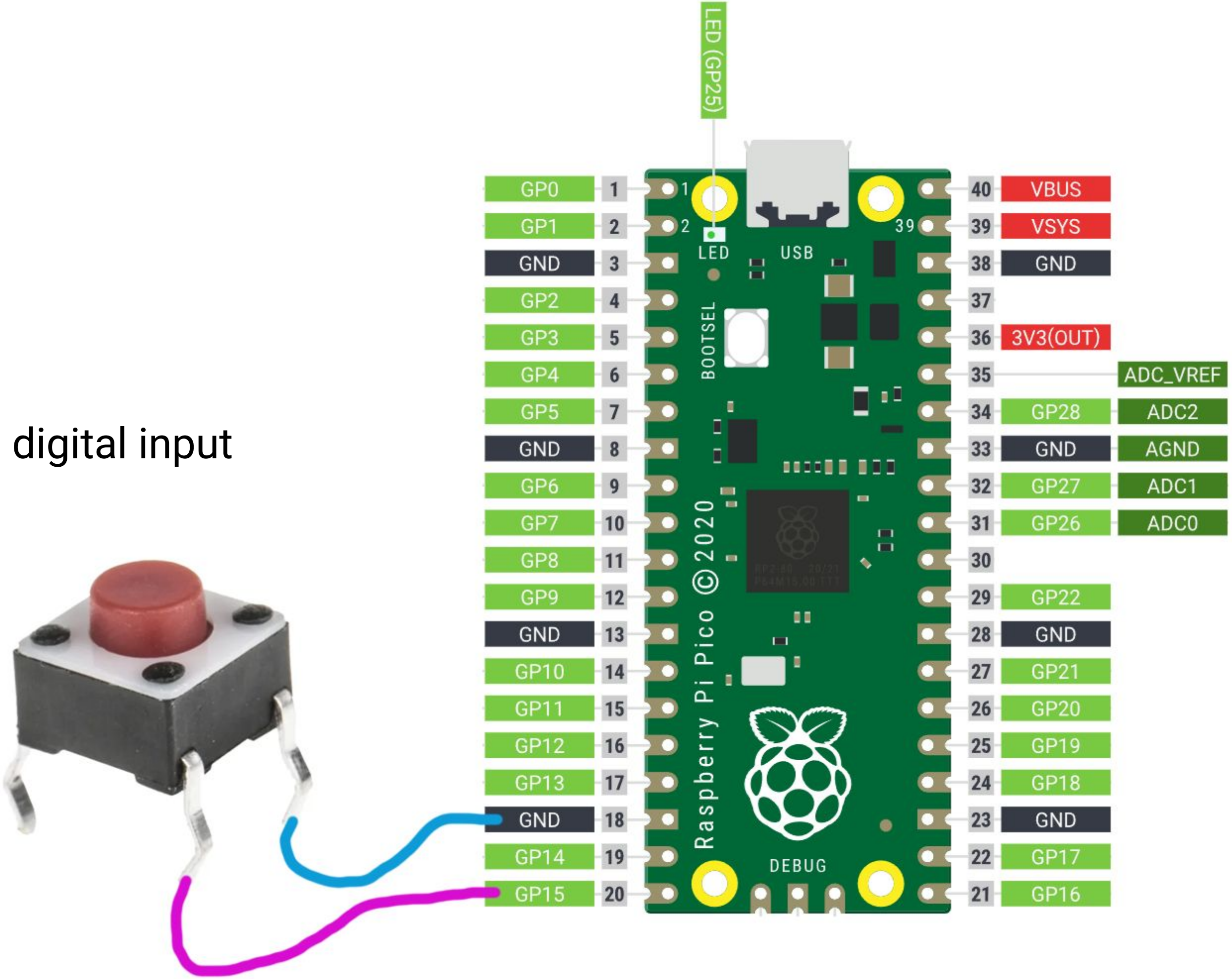
Building basic midi controller



M.I.D.I.

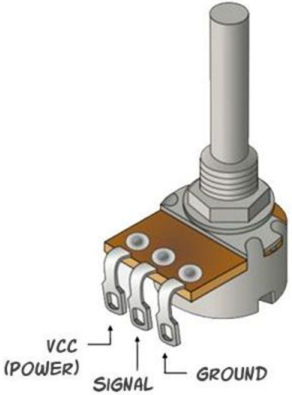
Building basic midi controller

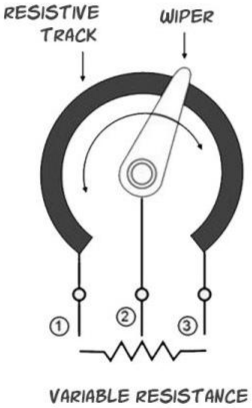
digital input

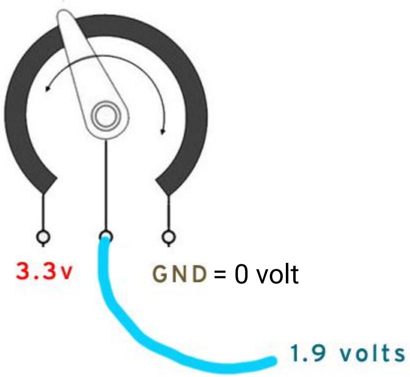


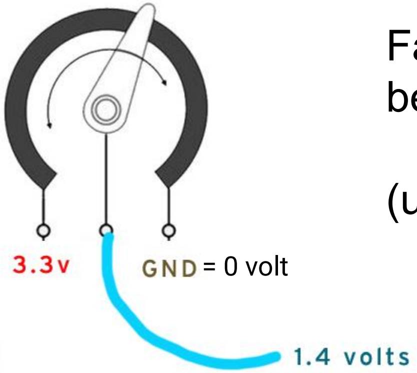
M.I.D.I.

Building basic midi controller









Potmeter overview

The Fader works exactly the same, different style / housing.

Potmeter: output is the middle pin (pin 2)

Fader: output position can vary between designs.

(usually labeled: pin 2)

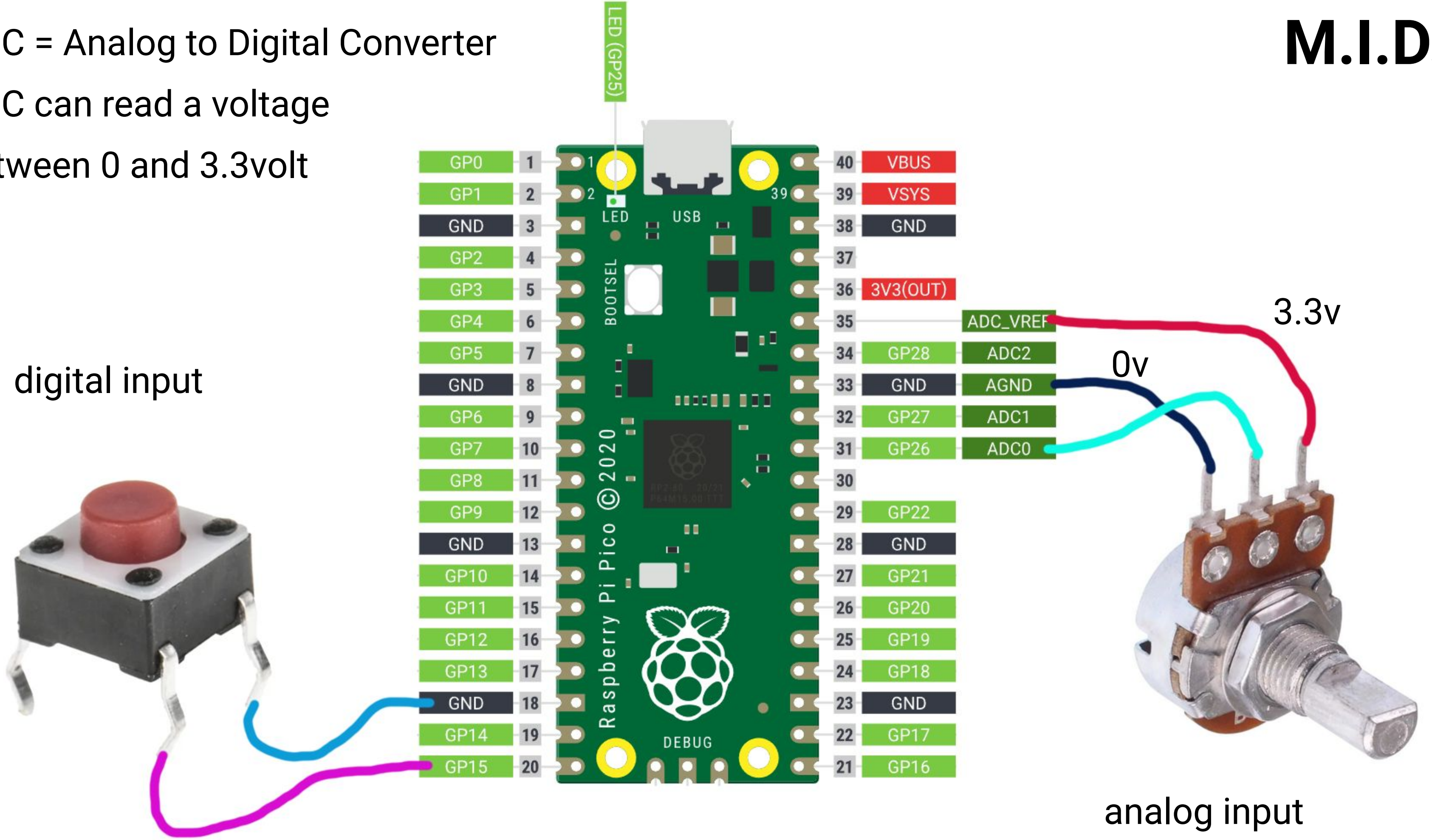
M.I.D.I.

Building basic midi controller

ADC = Analog to Digital Converter

ADC can read a voltage

between 0 and 3.3volt



digital input

analog input

[Coding Time]

Testing the hardware.

Install circuitpython library:

https://circuitpython.org/libraries or

https://github.com/adafruit/Adafruit_CircuitPython_Bundle

Copy the adafruit_midi folder to lib/ on the pico

[Testing]

Pure Data

https://puredata.info/downloads

Building basic midi controller