mBFY 2022
MicroPython for the Advanced Lab
June 17, 2022
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Outline

- Go to github.com/profhuster/mBFY22
- Introduction
- Install CPy on Lolin S2Mini

Comparison of Microcontrollers

Arduino Uno	Teensy 4.0	Lolin S2Mini (ESP32S2 chip)
2010 $25	~ 2018 $20	~ 2020 $4
16 MHz, 16-bit	600 MHz, 32-bit	240 MHz, 32-bit, WiFi
32 kB	2 MB + 1MB ROM	4 MB + 2MB ROM
No ADC	No ADC	Two ADC (quality low)
6 DIO, 6 ADC	40 General IO	26 General IO
Arduino IDE (C++)	Arduino IDE (C++) Hack MicroPython	Arduino IDE (C++) CircuitPython

MicroPython / CircuitPython

- Because of the speed of microcontrollers, MicroPython (uPy) was developed in 2014
- It runs directly on the chip
- Can run python files or interactively
  - REPL – Read – Evaluate – Print – Loop
  - Prompt is >>>
- CircuitPython was forked and developed by AdaFruit in 2017
- Very strong support for boards, expansion boards
- Tutorials, help on discord, forums

Why uPy/CPy

- Faster development through interactive REPL
- Mounts as a USB Drive
  - Drag & drop code to CIRCUITPY drive
- Python has easier learning curve
- Students want to learn and use python
- Students want to make!
- Very capable

MicroPython / CircuitPython Differences

MicroPython

- Goal Full Python 3 with libraries
- Not driven by AdaFruit
- Cutting edge
- Support for interrupt routines
- Supports inline assembly

CircuitPython

- Easier for learners
- Good support
- Lags uPy
- Limited, controlled interrupt
  - `countio` for Alpha Detector
- Safer

I use CircuitPython almost exclusively

Laser Beam Profiler

- Laser Beam Profilers are common measurements in laser optics labs
- This project demonstrates
  - Using I2C protocol for two devices, the stepper motor driver and the light sensor
  - Complicated 3D printed translation stage
  - Complex SPCI-like (Standard Commands for Programmable Instruments) control implemented in python
- NOTE: Right before the workshop, the motor driver quit working
- NOTE 2: Because of chip shortages I only have three kits

Alpha Particle Detector

- I like counting projects as a first Advanced Lab project
- This project demonstrates
  - CircuitPython `countio` library
  - Using a modern detector – SiPM photodiode
  - A pulse shaping circuit using a 3.3 V op amp
  - Lego for source mounting every 1.6 mm

Conductivity *versus* Temperature

- Conductivity/Resistance is a common condensed matter measurement
- My students have used it to measure High T_C superconductor transistions
- This project demonstrates
  - Using the chip DAC and ADC's to measure current through and voltage across a sample
  - Linear fit with uncertainties implemented in python
  - Thermocouple extension board using I2C protocol
  - Type-K thermocouple operates from 70 – 1400 K

Installing CPy on S2Mini

- Download and install CPy on S2Mini
- The Thonny editor
- Code 1 – CPU temperature
- (If time permits) Code 2 – Post temperature to Internet MQTT server