

babyIOC Control System in a Box Small Factor Solution

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Abstract

In the world of increasing complexity and integration, experiments often stretch over several beamlines or several facilities and require controls systems to accompany scientific equipment.

Back in March 2018 we faced the need to support mobile experiments at NSLS-II as well as the need for a quick prototyping and testing platform in the real production environment.

We developed a portable, small form factor solution that's easily reproducible, fully functional and tuned to the experiment.

babyIOC [1] can run one or more areaDetector [2] IOCs, depending on the number of plugins enabled.

SYSTEM AND SOFTWARE



Hardware Parts

- boots from microSD card
- x4 core 2.56 GHz CPU Intel
- 8G RAM
- x3 Gbit interfaces
- 1x HDMI
- 2x miniDP++ connectors
- 3 x USB 3.0
- 2x UART Serial ports
- IR interface
- Arduino 101-Compatible



babyIOC assembled

- CentOS 7
- areaDetector-3-6[4], build with
 - epics-base R7.0.2.2,
 - ipac R2.15, seq R2.2.6,
 - asyn R4.35,
 - autosave R5.9, busy R1.7,
 - sscan R2.11.2, calc R3.7.1,
 - ioc-stats R3.1.15
- USB device support for gamepad [6].
- X2Go server for remote access.

Selecting hardware

We have looked at Single Board Computers (SBC) offered by **Beagleboard, RaspberryPI, Nvidia, PINE64, UDOO [3], Boundary Devices, Hardkernel, PC Engines**, and others.

We have selected **Udoo X86 Ultra [4]**. This SBC has microSD card storage, 64-bit Intel architecture, 4-core 2.56 GHz, 8 GB of RAM, x3 1 Gbit interfaces (including dual port daughter card). The cost of board and extensions is ~\$400 US. We've configured it so the system boots and runs from microSD card. Building another system comes to copying the image to another microSD card.

We would like to note that hardware is evolving so fast that one year later, in 2019, better hardware can be found. For example, UDOO [3] is coming out with a new board UDOO Bolt with 4-core AMD Ryzen 4, 8-threads, 3.6 GHz CPU, funded by Kickstarter campaign in 2018 and available for preorder [5].

DEPLOYMENT EXPERIENCE

- quick new software deployment at XFP 17BM and CHX 11ID beamlines,
- areaDetector delivery tests
- ophyd tests for areaDetector upgrades
- quick prototyping and software development
- testing possible transition to CentOS

ISSUES AND LIMITATIONS

One instance of 128 GB microSD card, rating 1, required frequent disc checks. Similar cards from the same vendor worked well.

We have observed the OS killing areaDetector EPICS IOC if one enabled too many plugins and system starved for resources.

Intel HD Graphics 405, up to 700 MHz does not support XWindows, if installed.

REFERENCES

- [1] babyIOC, <https://oksanagit.github.io/babyIOC>
- [2] areaDetector, <https://areadetector.github.io>
- [3] UDOO <https://www.udoo.org>
- [4] UDOO Ultra <https://www.udoo.org/udoo-x86/>
- [5] UDOO Bolt <https://www.udoo.org/udoo-bolt/>
- [6] <https://github.com/keenanlang/epics-usb>