Agon, a modern 8-bit computer
by Lennart Benschop

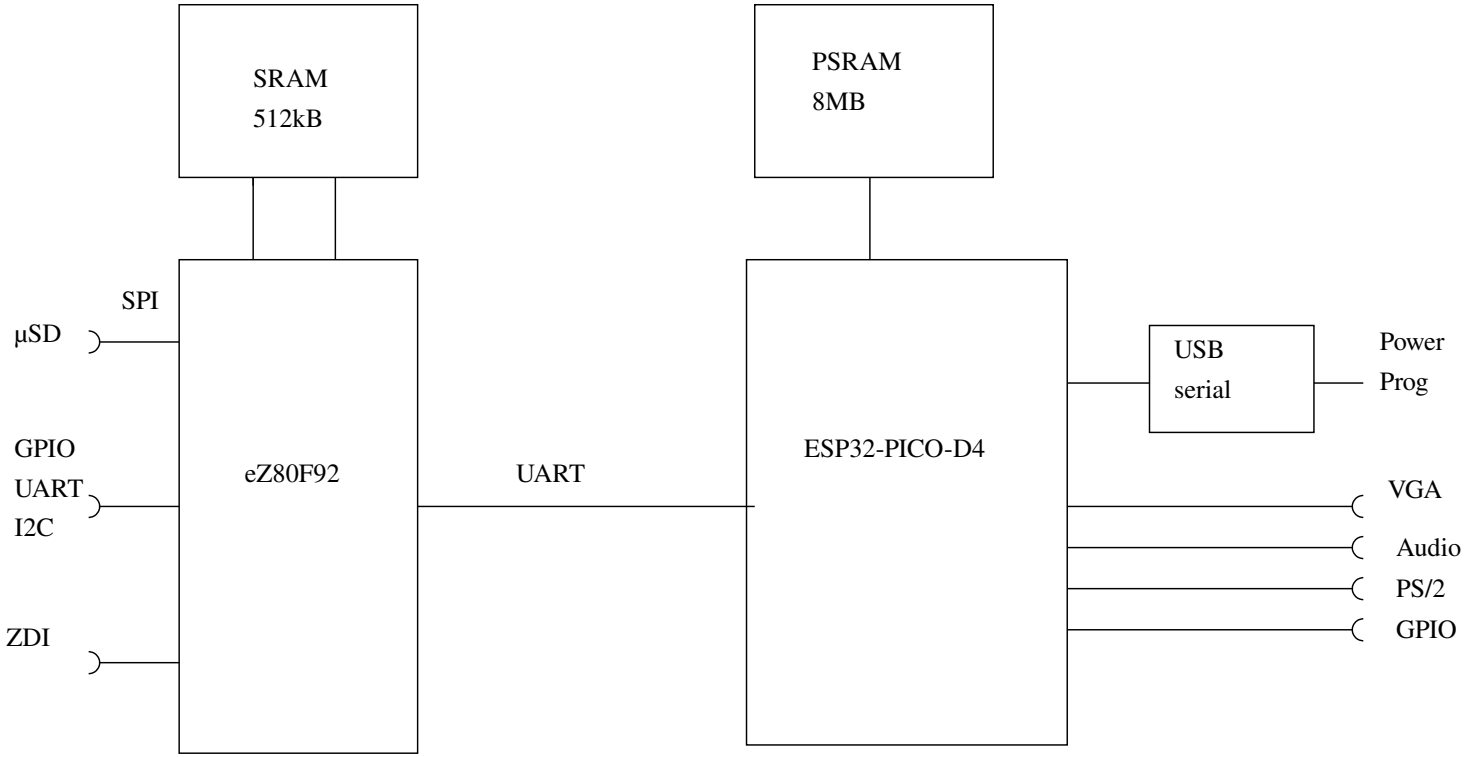
Agenda

- Hardware
- Firmware
- Software development
- Emulator
- Examples

Background

- Designed by Bernardo Kastrup.
- True 8-bit CPU, no FPGA.
- More RAM and more speed than any 1980s 8-bit micro
- Cost effective, modern SMD components

Hardware Block diagram



Hardware

- EZ80F92 at 18.432 MHz
  - Hybrid between microcontroller and microprocessor. Has built-in flash 8 kB of RAM, peripherals like SPI, I2C, UART, but also external bus.\
  - Extended Z80, Z80 mode with 16-bit addresses (can run existing Z80 software) and ADL mode with 24-bit addresses.
  - Far fewer cycles per instruction.

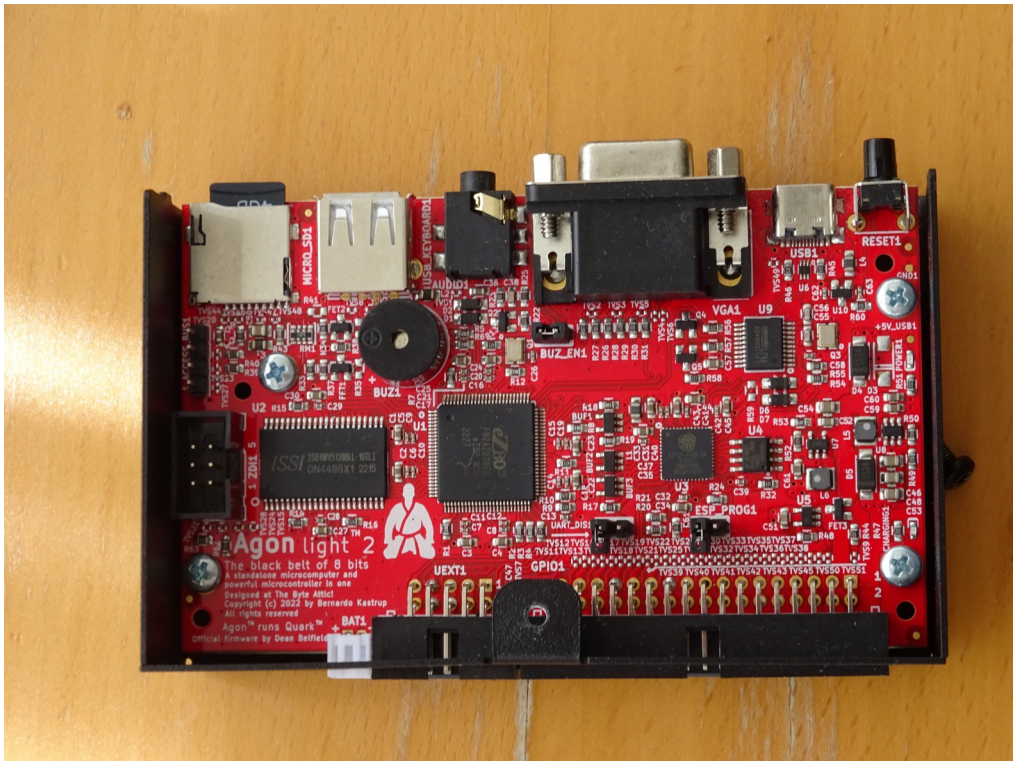
Hardware, VDP

- ESP32-PICO-D4
  - Dual-core Tensilica RISC CPU + 520kB on-board RAM + 8MB PSRAM
  - Generates VGA signal in software:
    - 640x480 @ 16 colours
    - 640x240 and 320x24 @ 64 colours
  - Audio 8-bit
  - PS/2 keyboard
  - High speed UART between eZ80 and VDP (1.152 Mbits/s)
  - BBC Micro style VDU command set.

Open hardware design

- Two current manufacturers.
  - Olimex (Bulgaria) Agon Light 2. https://www.olimex.com/Products/Retro-Computers/AgonLight2/
  - Heber (UK) Console8, slightly different board, mouse port, joystick ports. https://heber.co.uk/agon-cosole8/

Olimex Agon Light 2



Firmware

- Existing Open Source projects
  - FatFS library in C, to be run on eZ80
  - FabGL library in C++ on ESP32, video, audio, keyboard
  - BBC Basic v3 for Z80, by R.T. Russell.

Firmware

- Needed to write:
  - Kernel for eZ80 (system call interface)
  - Command line interpreter
  - ESP32 VDU command handler
  - Porting BBC Basic
  - System software

Memory Map (eZ80)

0x000000-0x01FFFF	Internal flash
0x020000-0x03FFFF	Reserved
0x040000-0x0AFFFF	Application RAM
0x0B0000-0x0B7FFF	MOSlet area
0x0B8000-0x0BFFFF	OS area
0x0C0000-0xB7DFFF	Reserved
0xB7E000-0xB7FFFF	On-chip RAM
0xB80000-0xFFFFFF	Reserved

Modes of eZ80

- Z80 mode:
  - Compatible with original Z80. LD B,B LD C,C LD D,D LD E,E taken away for size prefixes.
  - Some additional instruction: MLT, Load/store register pairs, LEA.
  - Undocumented Z80 instructions actually documented
  - 64kB addressable, 8-bit MB register selects location within address map.

Modes of eZ80

- ADL mode
  - All 16-bit registers extended to 24 bits
  - 24-bit add/subtract.
  - Access 16MB address space.
  - Cannot access the upper byte of a register separately, need to load/store entire register in memory.
  - Mixed mode calls, jumps, RST

System calls

- RST.L 0x08 main system call interface, call number in A register.
  - Read keyboard
  - Get pointer to system variables
  - File system calls (open, read, write, close, opendir, readdir)
  - Edit line,
  - Exec command
- RST.L 0x10 print character
- RST.L 0x18 print string
- RST.L 0x38 abort

Development environments (eZ80)

- Zilog ZDS-II
  - IDE
  - C and assembler
  - Windows only
  - Not open source
  - Freely available
  - Not very well maintained, old.
  - Debugger via ZDI interface, requires expensive cable, really really requires Windows.

Development Environments (eZ80)

- AgDev
  - ADL mode
  - Based on LLVM, open source
  - C and assembler (and some C++)
  - stdio library simulates redirection.
  - Uses fasmg as assembler, slow and x86-only.
- agondev
  - Similar, but uses sane assembler.

Development Environments (eZ80)

- Forth
  - Self-hosting.
  - Contains assembler
  - 16-bit and 24-bit versions
- Ez80asm
  - Assembler, runs on anything that runs C, including Agon itself.
- Bsimple
  - High-level language, simpler than C.
  - Compiler can run on Agon itself.

VDP firmware (ESP32)

- Like a very fast serial terminal.
- Key presses, responses to some commands, sent to eZ80.
- Handles VDU commands, (BBC style).
  - PLOT, COLOUR, set cursor, change screen mode, set viewport.
- VDU command extended
  - Write buffers (bitmaps audio samples, fonts)
  - Play audio.
  - Sprites
  - And much more

BBC Basic versions

- Original Basic v3
  - Z80 mode.
  - Same commands as BBC micro
- BBC Basic ADL
  - ADL mode, can use all RAM.
  - Assembler has full eZ80 instruction set
- BBC Basic v5
  - Z80 mode
  - Adds v5 extensions, like WHILE, multiline IF/ENDIF, matrix ops.

Fab-Agon-Emulator

- Written in Rust and C++ (VDP firmware).
- Uses SDL2, cross platform (Unix, Win, Mac)
- Contains debugger
- Runs eZ80 firmware image.
- Traps file system calls for host fs access, can also use card image.

Applications

- Text editors: nano, vi, aed
- Shell utilities, like wc, grep, sort.
- Games: rokky, sokoban, invaders, lander.
- Mc (Midnight commander lookalike).
- Flash update tool
- CP/M
  - CP/M port working with disk images.
  - Zinc, uses host files.

Show Time