



VIRTUAL COURSE
**BUILD YOUR OWN
DATA LOGGER**



WILDLABS.NET

[The conservation technology network]

FREAKLABS



MODULE 1-2B

**UNDERSTAND THE FULL
DESIGN STACK - MEMORY
POWER**

Memory

Different types

Random Access Memory (RAM)

- Can read / write
- Very fast
- Volatile = loses data when power is off
- Variables in our app will be stored here
- `Println()` uses RAM

Flash Memory

- Can read / write
- Very fast
- Non-volatile = doesn't lose data when powered off
- Our compiled application code will be stored here

Memory Considerations

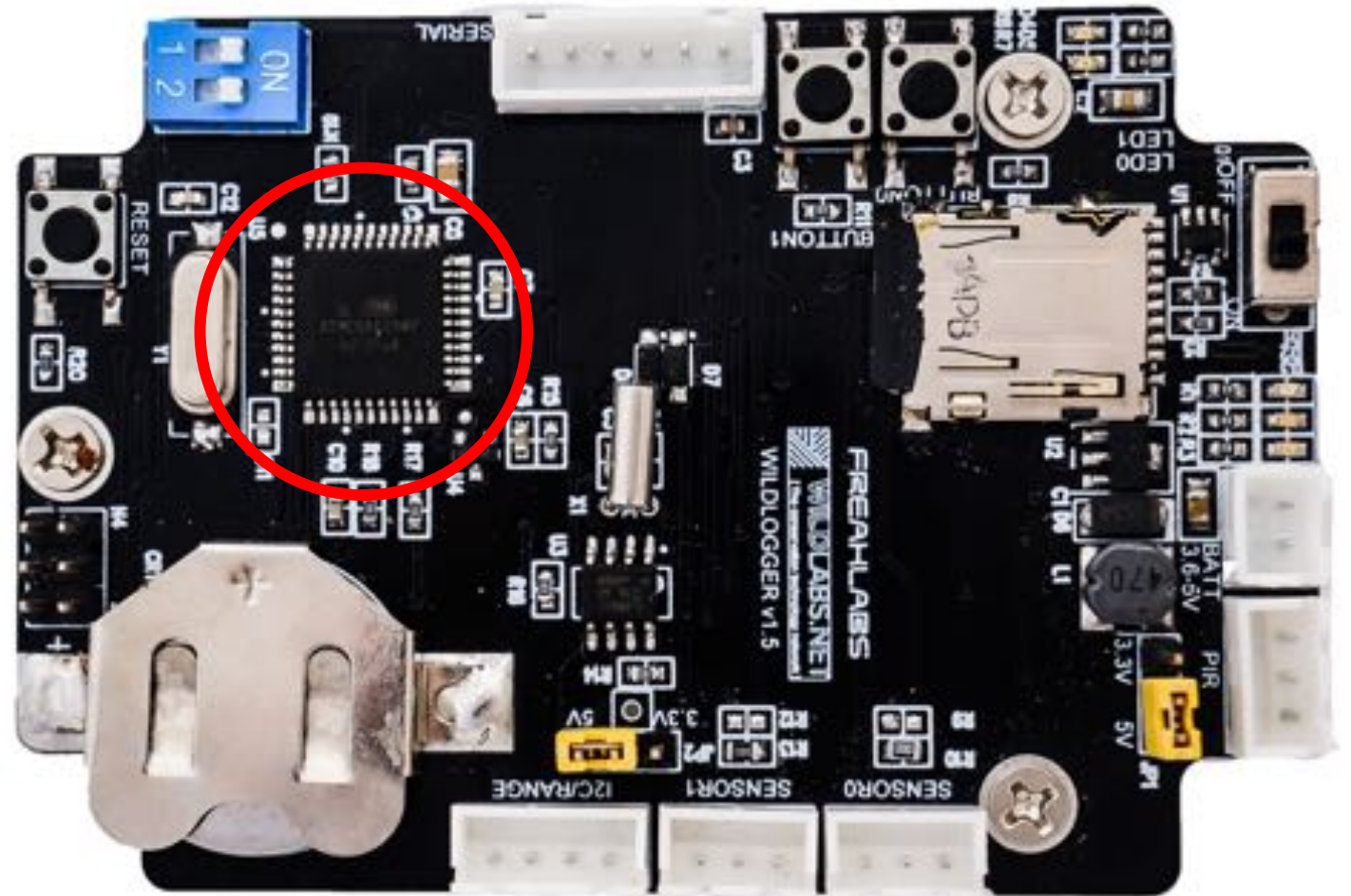
- ATmega328P (Arduino Uno): 2k RAM, 32KB Flash memory
- To deploy the devices, we're adding power optimization, SD storage and more, so need more memory.
- ATmega 1284P (WildLogger) : 16k RAM, 128 KB Flash memory
- Biggest consumer of memory is file system (eg. SD card)
- ASCII text uses lots of RAM
- CSV uses less RAM than data formats like JSON

Microcontroller (MCU)

ATmega 1284P

- 16kb Ram
- 128 kb Flash Memory
- 3.3V -5V
- 32 input / Output pins include 8 Analogue pins

Different chip on standard Arduino (eg Arduino Uno).



Power Consumption

- Low power consumption of a device is crucial for deployment
- The amount of power device uses determines its life-span
- Life-span of a device is how long it can stay in the field before running out of power
- Lower power consumption of a device = longer life-span
- Power consumption determines how big the power supply needs to be eg. how many batteries, how big a solar panel
- **more power = higher voltage = shorter battery life OR bigger batteries**

Determining Power Consumption

Two power consumption modes we're concerned with:

- Sleep mode = everything connected to the circuit board but it's asleep
- Active mode = everything connected and active (eg. LEDs and all sensors)

Q. What's the total current the system consumes in either or both of the modes?

Current

- Current is the **rate at which electric charge flows around the circuit**
- Measured in amperes (A) and ampere-hours (Ah)
- **Ampere-hour (Ah)** is the electric charge that flows in electrical circuit, when a current of 1 ampere is applied for 1 hour

- For devices like ours, we'll be talking about current in microAmps (μA) and milliAmps (mA)
- $1\text{A} = 1000\text{ mA}$
- $1\text{mA} = 1000\ \mu\text{A}$

Measuring Current

- Datasheets include how much current the peripheral or component consumes
- Measure system current with a multimeter
- Use a quick 'back of the envelope' calculation to get a ballpark for life-span, then test during pilot phase

battery current (mAh) / current in sleep mode (mAh)

= number of hours before batteries die

Number of hours before batteries die / 2 or 3 = more realistic battery life

WildLogger Power Consumption

- Active Mode = 45 milliAmps
- Sleep Mode = 800 microAmps = .8 milliAmps (*Bit higher than usual because SD card consumes lots of current*)
- Runs on 1 x AA battery = 2000 milliAmp hours (*3 x AA batteries just adds higher voltage*)

$$2000 / .8 = 2500 \text{ hours}$$

= Theoretical 100 days of battery life on 3 x AA batteries.

$$100 / 3 = \text{approx. 3 months life-span}$$

Power Saving Tips

If you need to increase life-span,

- decrease voltage the system needs OR increase batteries
- Make sure you have a realtime clock / calendar so you can put the device to sleep and wake it up only when it needs to do something
- Reduce the 'awake' time of your device

Battery - Voltage

- **Voltage** is **pressure** from a power source (battery) that pushes the electrical current through a circuit
- Voltage for hardware (eg circuit board & sensors) is either 3.3v or 5v
- Voltage of peripheral, components and circuit board needs to be compatible
Most sensors now are 3.3v compatible. Eg. DHT11 is 3.3v compatible.
- WildLogger board is 3.3v or 5v. Sensor ports are 3.3v
- WildLogger uses standard 3 x AA batteries = $1.5\text{v} \times 3 = 4.5\text{v}$
- Circuit board usually has circuitry which raises or lowers the voltage for a piece of hardware to make everything work together

A photograph of an electronic circuit board, possibly a microcontroller or sensor module, with a black battery connected to it. The board has various components like a blue capacitor and a white connector. The background is a light grey surface. The text is overlaid on the image.

COMING UP - 1-3

**UNDERSTAND THE FULL
DESIGN STACK - SOFTWARE**

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