

AVR101

OHM version

Netz39 e. V.

<http://www.netz39.de/>

2013

Overview

Why?

- Learning Things
- Uses Cases

Needed Things

- Microcontroller
- Circuits
- Programmer
- Software

Flashing the Device

- avrdude
- All the Ugly Stuff

Hello World

- LED Blinking

Contact

Learn All The Detailz

- ▶ CPU
- ▶ Register
- ▶ Memory
- ▶ Interfaces and Ports
- ▶ ...

Assembler and C

- ▶ close to CPU
- ▶ efficient (if you're doing it right)
- ▶ available for microcontrollers
- ▶ standard in embedded world
- ▶ dependent on uC none or very few alternatives
- ▶ ...

Where?

- ▶ Industry
- ▶ Home
- ▶ Multimedia
- ▶ Automotive
- ▶ Communications
- ▶ Space
- ▶ ...

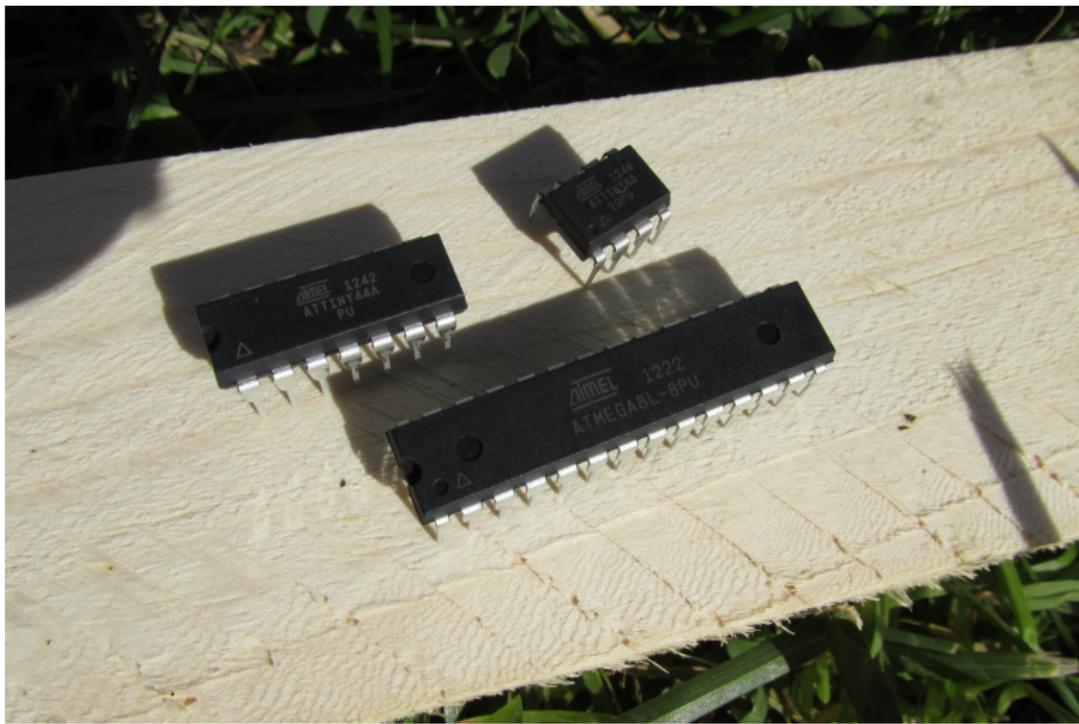
What?

- ▶ Light Emitting Stuff
- ▶ Quadrocopter
- ▶ Human Interface Devices
- ▶ Home Control Foobar
- ▶ Measuring Devices
- ▶ Programmer
- ▶ ...

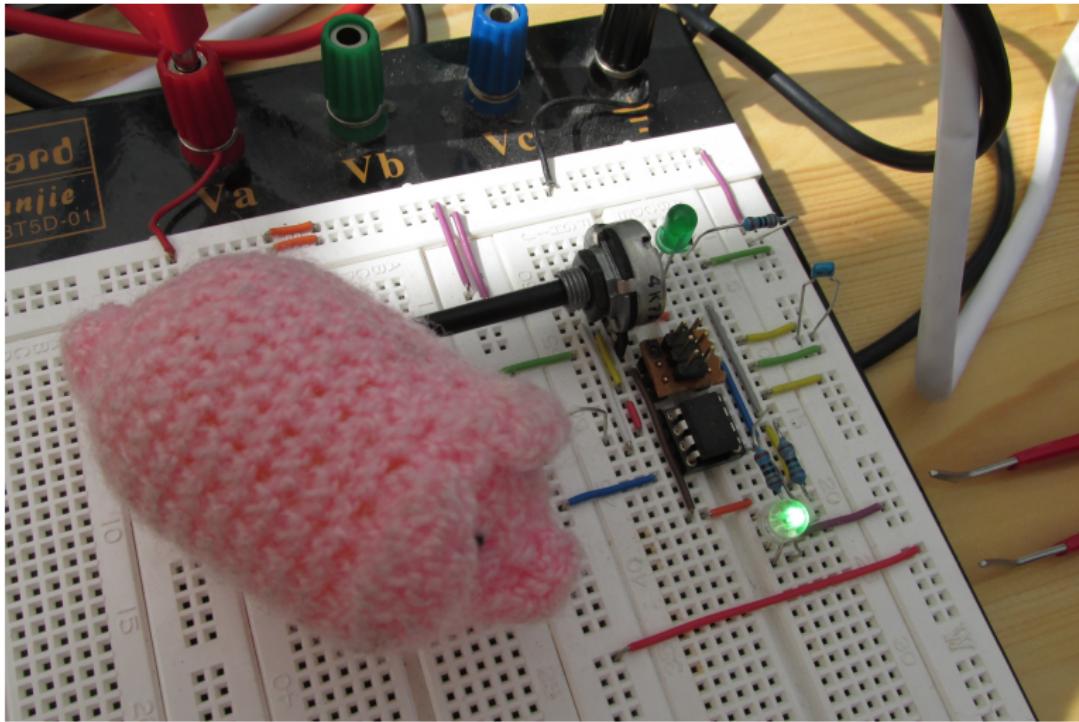
Families

- ▶ Atmel AVR
- ▶ Microchip PIC
- ▶ Intel 8051
- ▶ C166/C167 (Siemens/Infineon)
- ▶ Renesas R8C/M16C/...
- ▶ TI MSP430
- ▶ ...

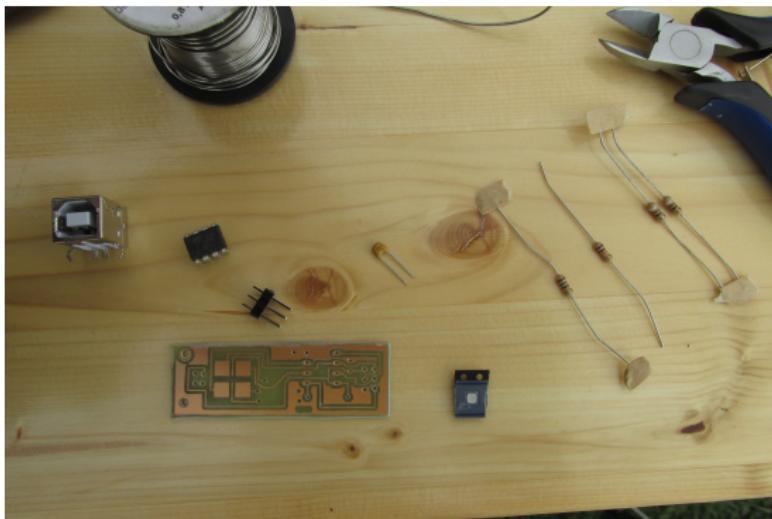
ATtiny and ATmega



Breadboard

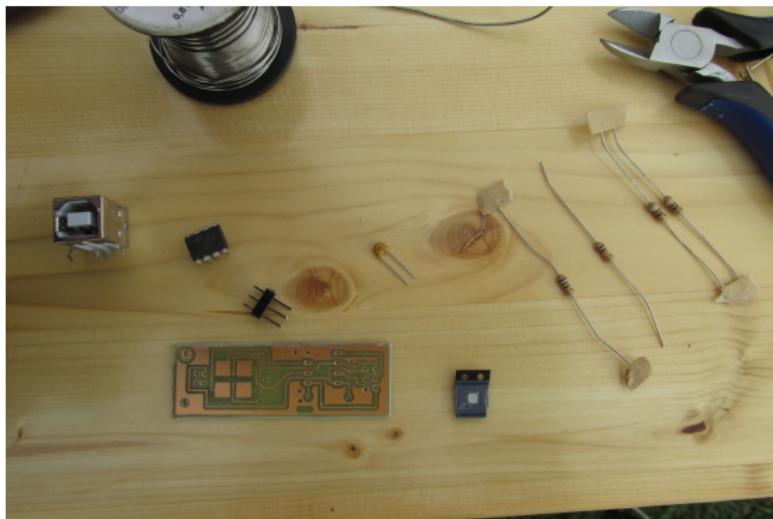


Kits



- ▶ <http://www.netz39.de/projekte/starterkit/>

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- ▶ AVR STK 500: $\approx 85\text{ €}$

Arduino and other devices

- ▶ works even for this workshop
- ▶ works with breadboard arduino clones
- ▶ works with your 2nd usbtiny programmer
- ▶ any circuit with AVR, LED and ISP header will do

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Warning

You'll destroy the bootloader/firmware of your device and have to restore it if you want to use it as before.

Programming Devices

- ▶ AVR ISP2: $\approx 40 \text{ €}$
- ▶ AVR DRAGON: $\approx 50 \text{ €}$
- ▶ JTAG ICE 3: $\approx 115 \text{ €}$
- ▶ JTAG ICE MK II: $\approx 345 \text{ €}$

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- ▶ serial (RS232)
- ▶ USB, e. g. *usbtiny*
- ▶ any SPI-Device like Arduino, Raspberry Pi, r0ket, ...

AVR Studio

This is M\$ Windoof, who uses this?

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(Not covered in this workshop!)

Linux

GUI anyone?

CLI rulez!

- ▶ gcc-avr
- ▶ binutils-avr
- ▶ avrdude
- ▶ avr-libc
- ▶ \$EDITOR
- ▶ any version control (Mercurial, Git, Subversion, ...)

avrdude

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- ▶ -P port – e.g. usb
- ▶ -t – test connection

avrdude

- ▶ see ‘`man avrdude`’

Bootloader

This is advanced stuff!

Fuse Bits

- ▶ *not needed in this workshop*

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- ▶ <http://www.embedded.com/fusecalc>

Makefile

```
PGM = avriscp2
CPU_GCC = attiny25
CPU = t25

F_CPU = 1000000

CDEFS = -DF_CPU=$(F_CPU)
CFLAGS = -mmcu=$(CPU_GCC) $(CDEFS) -Wall -Os

.phony: clean

all: rgb.hex

program: rgb.hex
        avrdude -c $(PGM) -P usb -p $(CPU) -U flash:w:rgb.hex

clean:
        rm *.o *.elf *.hex

rgb.hex: rgb.c
        avr-gcc $(CFLAGS) -c rgb.c -o rgb.o
        avr-gcc $(CFLAGS) rgb.o -o rgb.elf
        avr-objcopy -R .eeprom -O ihex rgb.elf rgb.hex
```

Simple Approach

```
#include <avr/io.h>
#include <util/delay.h>

int main (void) {
    DDRB = (1 << DDB0);

    while (1) {
        PORTB = (1 << PORTB0);
        _delay_ms( 100 );
        PORTB = 0;
        _delay_ms( 100 );
    }

    return 0;
}
```

Pulse Width Modulation

- ▶ on on on on off off on on on on

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- ▶ *add nice plot here, TikZ anyone?*

Pulse Width Modulation

- ▶ on on on on off off on on on on
- ▶ *add nice plot here, TikZ anyone?*
- ▶ not linear with perceived LED brightness
- ▶ don't fear pre calculated logarithmic lookup tables

Timers

- ▶ count up or down
- ▶ count to a certain value
- ▶ count endlessly till overflow
- ▶ count external events

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- ▶ count external events
- ▶ you really need the micro controller documentation!

Contact

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License

Slides and Pictures

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Source at: https://github.com/netz39/avr_101