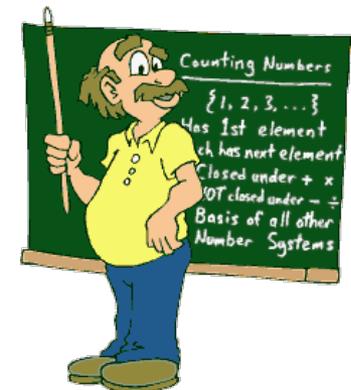


SW-AMS

Appled Microcontroller Systems (5 ECTS , Forår, E / SW)

Course Overview



SW-AMS: Motivation

- Microcontrollers are widely used as controlling elements in embedded systems.
- This course teaches relatively advanced aspects in developing microcontroller based systems.
- The course gives the necessary basic knowledge for further qualified work in embedded development teams – doing hardware close programming / software close hardware.

Learning Objectives

- Use In Circuit **debug tools** (JTAG ICE).
- Implement **drivers**, dealing with **time critical** parameters.
- Implement **Boot Loaders** for updating microcontroller firmware.
- Use **operating systems** for microcontrollers (Free RTOS).
- Use **SD cards** as external flash memory.
- **WEB-enable** a microcontroller.
- Use **USB** to interface a microcontroller.
- Use microcontroller knowledge in a **final mini project (😊)**.

| | |
|------------------|------------------|
| 7-8 weeks | 6-7 weeks |
| Lessons + LABs | AMS project |

Course Schedule (2022)

| Week | Date | Topic | Other on class activities |
|------|--------------|--|-------------------------------|
| 1 | 2. February | Introduction and Hands On (lesson + LAB1) JTAG debugging (LAB2) | |
| 2 | 9. February | Alphanumeric Display Driver (introduction + LAB3) If time for it: Start next topic (Graphic Display driver) | Comments on JTAG debugging |
| 3 | 16. February | Graphic Display Driver (lesson + LAB3a) | Discussing the LAB3 solution |
| 4 | 23. February | Introducing Boot Loading (lesson) Boot Loading (LAB6) | |
| 5 | 2. March | Introducing FreeRTOS (lesson) FreeRTOS (LAB7) | Discussing the LAB3a solution |
| 6 | 9. March | Finish LAB6 and LAB7. Starting the project work. | Discussing the LAB6 solution |
| 7 | 16. March | Applied USB (lesson, part 4). Applied USB (LAB8) | Discussing the LAB7 solution |
| 8 | 23. March | SD card driver (lesson) SD card driver (LAB9) | Discussing the LAB8 solution |
| 9 | 30. March | WEB enabling (Wifi) (LAB11) | Discussing the LAB9 solution |
| 10 | 6. April | Optional: Touch Screen Driver (LAB10). Project work. | Discussing the LAB11 solution |
| 11 | 20. April | Project work. | |
| 12 | 27. April | Project work. | |
| 13 | 4. May | Project work. | |
| 14 | 11. May | Project work. | |
| - | 1. June | Deadline: Project Report Hand in (using AU Digital exam) | |
| - | 20.-21. June | Exams | |

Contents

- Atmel AVR 8 bit controllers / (+ other controllers).
- AVR GCC C-compiler (Atmel Studio 7) for LABs.
- JTAG ICE (In Circuit Debugging tool).
- Bus timing (eg. interfacing LCD displays).
- Boot Loading.
- SD Cards (raw data + FAT).
- WEB enable a microcontroller (client side).
- Embedded RTOS ("Free RTOS").
- USB interfacing (protocol).
- (Intercomponent busses (eg. SPI and I2C)).
- Microcontroller mini project (½ half the course):
Students own proposals !

ASE "Embedded Stock"

EmbeddedStock

Q arduino|

Find component by name or description



Adafruit Ultimate GPS Logger Shield

This GPS shield incl. GPS module works great with either UNO or Leonardo Arduinos and is designed to log c maybe a music player that changes tunes depending on where you are in the city. <http://www.adafruit.com/fo>



Micro SD Module - SC13017

This 3.3v I/O POD has a socket for a micro SD card. The device is SPI, so is supported by the Raspberry Pi, B (cables etc) without even picking up a soldering iron. The POD range was designed to be simple, fast and co /cisecco-b026-i-o-pod-microsd-card-socket-3-3v-spi-communication-73-4833



ATmega32u4 Breakout board (Arduino Leonardo)

This Breakout board is based on a ATmega32u4 - AVR core with USB capability. Plug it in, connect a mini-B U need an AVR programmer. <http://www.adafruit.com/products/296>



MCP4725 DAC Breakout - I2C

Description: You've always wanted to output analog voltages from a microcontroller, the MCP4725 is the DAC DAC allows you to send analog signal, such as a sine wave, from a digital source, such as the I2C interface o musical instruments, and many other creative projects! This version of the MCP4725 Breakout fixes a few is dimensions to better fit your projects, and a few more minor tweaks. This board breaks out each pin you will



Soil moisture sensor module

En simpel jord-fugtighedssensor, velegnet til at måle vandindholdet i din plantejord, i potteplanter eller drivhu omvendt ved lav fugtighed. Dette output kan da overføres til din MCU og bruges til vandingsvarsling eller sty



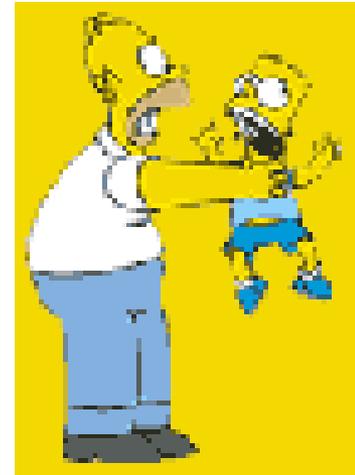
NFC/RFID Controller Shield for Arduino

We've taken our popular Adafruit PN532 breakout board and turned it into a shield - the perfect tool for any 1

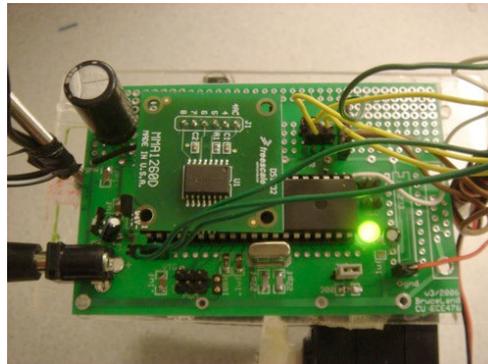
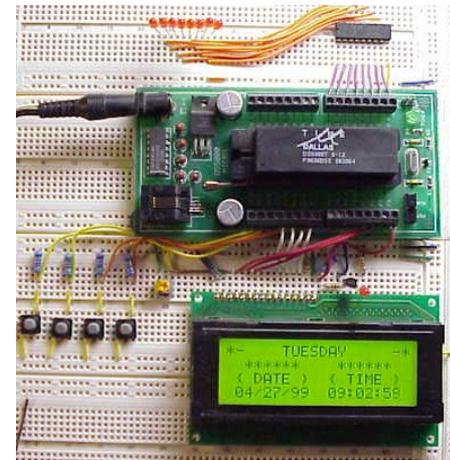
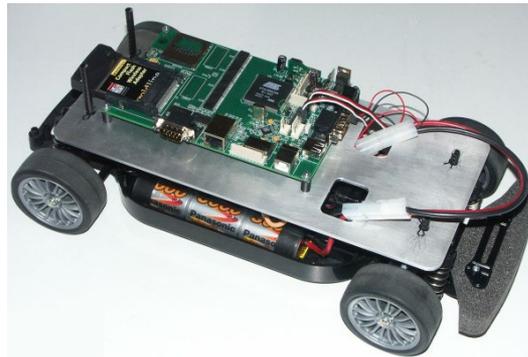
[Link til Embedded Stock](#)

Oral examination

- Project demonstration (whole group) on video uploaded as an appendix to the report.
- Individual oral examinations based on the project work (report + video).
- Individual marks.
- External examiner.



The AMS Project



Project examples (prior AMS course) (1)

- Motor cycle Cruiser.
- Weather station with humidity sensor.
- Digital barometer.
- Decoder for the DCF77 radio signal (Frankfurt).
- Bar code reader.
- Boot loading.
- PC controlled voltmeter.
- IrDA communication for cellular phones.
- SMS interface via GSM modem.
- MIDI player.
- B&O/Philips IR -> Playstation 2.
- Digital Equalizer.
- Project with MCP2510 CAN controller.

Project examples (prior AMS course) (2)

- CAN controller.
- USB and microcontrollers (theoretical project).
- Magnetic card reader.
- Ping-pong game with graphic display.
- Weight scale with counting feature.
- Alarm Clock playing tunes.
- Driver for SJA1000 CAN controller.
- MIDI Controller for controlling guitar effects.
- Robotic vacuum cleaner.
- Project with DS18S20 temperature sensor.
- Motor Control using PWM.
- Controller for solar collector.
- Datalogger with MMC flash card.
- Info system using digital speech.

Project examples (prior AMS course) (3)

- DCF77 synchronized watch.
- Watch with calendar (+ temperature measurements).
- Electronic weathercock (wind speed og direction).
- Thermostat with alarm function.
- Game with graphic display.
- Embedded WEB server.
- Pump Controller.
- Controller for softdrink machine.
- General purpose IO card with ADC.
- PacMan game with graphic display.
- IrDA communication between AVR Boards.
- Weather station controlled by SMS.
- Boot Loader.
- GPS receiver.

Project examples (prior AMS course) (4)

- Channel Selector with Spectrum Analyzer.
- Interface for IDE disks.
- Light sensitive robot.
- GSM modem with SMS.
- Greenhouse Controller.
- Robot Car.
- Voltmeter with graphic display.
- Weather station with GSM-I.F.
- Traffic-speed measurer.
- Weather station with Real Time Clock.
- Fan Controller.
- Controller for steam locomotive.
- Mobile robot.

Project examples (prior AMS course) (5)

- LED watch.
- GSM/GPS burglar alarm.
- Temperature-measurer with SMS interface.
- Thermostat with SMS interface.
- SMS transmitter/receiver.
- P-NET slave using Mega16.
- Car Computer.
- USB interface.

- Etc, etc, etc and etc.....

Lecturer



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Further questions ?
Feel free to send me an email – or come and ask
questions at the workshop 😊

That's it

