

# Programming Embedded Systems

## ***Project overview***

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# On the elevator lab ...

- General quality of solutions is very good
  - For most groups, only small issues remaining/to be fixed
- Unfortunately, correction is taking us longer than expected ...
- **Stay tuned**

# Project overview

- Group projects to put material from the first half to practice
- Groups of 3-4 people
  - Larger than for the elevator lab
  - E.g., groups from the lab could merge for the project
  - **You have to sign up yourself on the student portal**

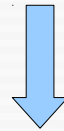
# Course grade

Project grade  
(groups, 3, 4, 5)

Exam grade  
(individual, 3, 4, 5)



Average  
(rounding upward)



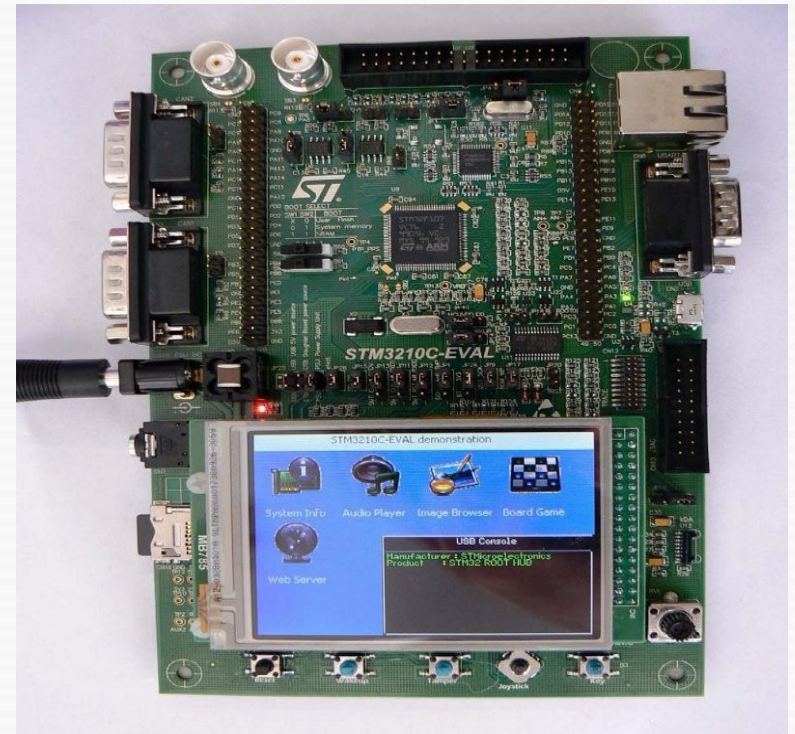
Individual  
overall course grade  
(3, 4, 5)

# Schedule

- March 21 – 27:  
Forming groups, definition of projects
- March 27:  
**Deadline for submitting project description**
- Now – May:  
Work on project
- Before May 25:  
**Presentation of project results**
- (May 25: exam)

# Main provided hardware

- STM3210C-EVAL
- STM32F107VCT  
ARM Cortex M3
- 256KB Flash,  
64KB RAM
- LCD, touchscreen,  
LEDs, buttons,  
joystick, etc.
- Programmable using  
MDK-ARM



## Provided hardware (2)

- Peripherals + further components might be added as needed for projects
  - Switches, buttons, ...
- Some groups might want to use alternative hardware

# Provided hardware (3)

- Once you have signed up for groups, you can receive boards from us
- Two possibilities:
  - You use boards **only during the scheduled lab hours**, bring them back afterwards
  - You can also keep a board for **duration of the course**; then you have to sign a paper that you are responsible



# Lab sessions

- We provide help during lab sessions (room 1313)
- Schedule in TimeEdit, and on course website
- Usually 2h twice a week

# Project examination

- By presentation
- You are expected to
  - **Demo** the thing you implemented
  - Prepare some **slides**:  
objectives, results, experiences, main difficulties, amount of time needed, lessons learnt

# Project topics

- Generally:  
**You can decide quite freely what you want to do**
- We propose a number of possible topics
- Topics will usually require you to collect additional background knowledge

# Hardware vs. Software

- Projects can be more ...
  - **hardware-oriented:**  
add peripherals, further components, etc. to board, + software
  - **software-oriented:**  
stick with hardware features provided on board, concentrate on software system using those
- Unfortunately, we have limited lab facilities (mostly 1313)
- But you might already have access to own hardware, or some lab (Ångström?)

# Audio system

- Reads audio using A/D converter, some processing, then convert back to analogue signal
- **Possible features:** effects, equaliser, frequency display, graphical user interface
- Can require implementation of signal processing algorithms, e.g., FFT
- Challenges: reading audio data efficiently, buffering scheme, performance

# Calculator

- Design and implement a pocket calculator
- LCD display for output, touch screen or buttons for input
- **Possible features:** function plotter, programming language, complex numbers
- Requires knowledge about GUIs, compilers, etc.
- Quite open-ended

# Multimeter/Oscilloscope

- Voltages, currents, resistance, capacities, frequencies
- Recording of data series
- Graphical presentation of measured values
- Hardware proficiency required

# Alarm system

- Implementation of alarm system  
e.g., protecting a house
- System connected to various sensors
  - Observing doors, windows
  - Motion
  - Connected to camera (webcam)?
- Some hardware proficiency needed



# Network analyser

- Device for analysing + bug-fixing IP networks (ethernet)
- Automatic collection of information about a network
  - Determine range of network addresses used in a network
  - Availability of servers (e.g., DHCP)
  - Scanning
- Knowledge about networking required

# Motor controllers

- Induction motor: brushless electric motor, controlled by AC input (polyphase or single-phase)
- To be controlled/taken into account: input voltage/frequency, motor speed, torque, heat, ...
- PWM to generate motor inputs
- User interface to control motor

# Project skeleton

- To simplify things in the beginning
- Similar to lab + home assignments
- In particular: API for LCD + touchscreen
- **Extensions will be necessary:**
  - e.g., further drivers

# To consider: drivers

- Common problem observed last year: getting **hardware features** to work can take much time (e.g, USB, flash file system, ethernet)
- Various drivers + examples are available at [www.st.com](http://www.st.com) (some binary-only)
- We can provide advice + example code for some features, but not for all

# How much to do?

- Depends on difficulty of topic, etc.
- Guideline:
  - Project is worth 4hp
  - **$4\text{hp} * 4 \text{ (people) / ( 1.5\text{hp} / \text{week} )}$**   
 **$\approx 10.5 \text{ person weeks}$**

# Joint projects with other courses

- **Welcome!**
- (One group already decided to do a joint project with Bengt Jonsson's course)
- Wireless sensor networks course?

# Contents of project proposal

- **General description** + motivation of chosen topic
- **Objectives/requirements:**
  - Which features do you want to have implemented in the end?
- **Feasibility:**
  - How do you want to realise the project?
- 2-3 pages are enough

# Next steps (by next Tuesday)

- Choose groups and sign up on student portal
- Think and decide about project topic
- Write project proposal, and submit it on student portal