Master Practical Course: Edge Computing and the Internet of Things

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06.07.2023

Original material/concept by *Teemu Kärkkäinen*

Why are we here?

Learning by doing:

You can pass exams without ever learning anything;

you cannot design and build a system without learning.

Why are we here?

Idea: *Emulate a product/service development project.*

From an idea to a documented prototype.

Using a variety of devices and technologies.

Why are we here?

Key elements:

Team

People to work and learn with.

Equipment

Real devices to build with.

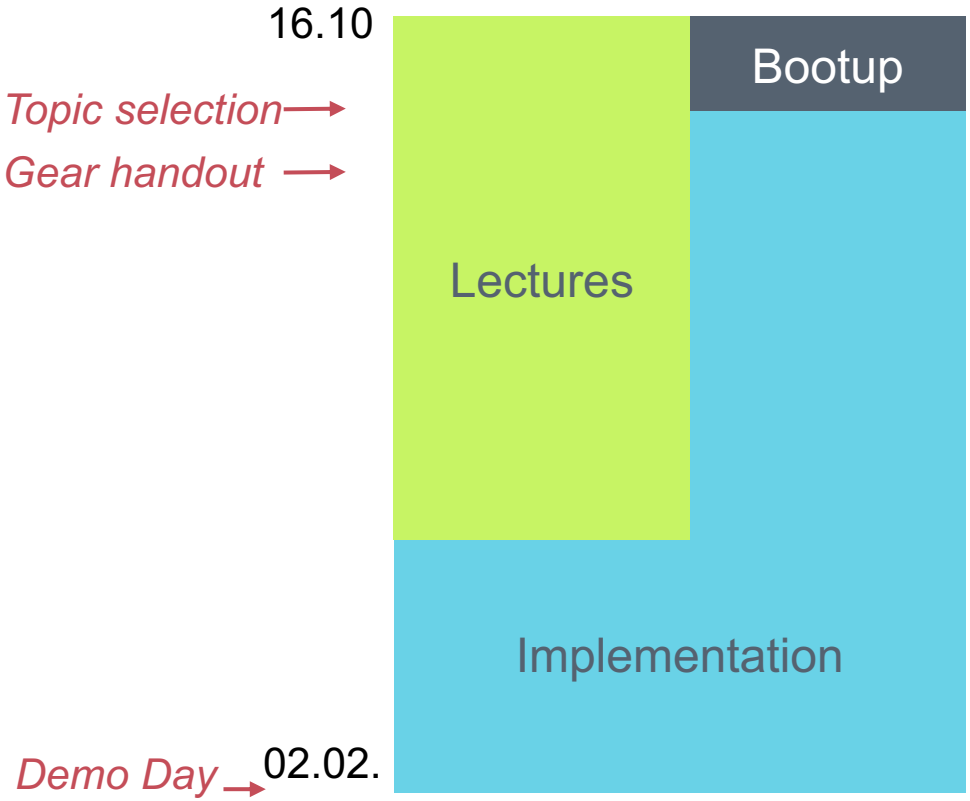
Goal

Clear goal and a structured path towards it.

Time

Full semester, lots of credits.

Course Structure



Developing a project idea.

Implementation **sprints**.

Progress meetings:

Every other Friday

Rough Schedule

*10 ECTS / 60 days = 10 ECTS * 25 h/ECTS / 60 days*
= ~4 h/working day

Lectures

Monday 16:00–18:00, Room 01.07.023

Covers technologies and approaches needed for successful projects.

Strong **SHOULD** attend (email the lecturer if you will miss a lecture).

Practical Sessions

Every other Friday 13:00–17:00, Room 01.07.023

Progress update for all teams + discussion.

Implementation

Continuously updating repository

Project Management

Intensive development effort will fail without *structure*,
but we're not here to run a *bureaucracy*.

Scrum-ish project management:

Backlog:

Tasks go into the backlog (issue tracker).

Work is done from the backlog.

The backlog is changed, ranked and tracked.

Visible to the course staff.

Bi-weekly presentations:

What was done, what will be done, any problems.

Equipment

We provide a list of equipment available.

Range of consumer devices available today.

Each team will choose their needed equipment.

Based on the project.

We will provide sets of equipment to the teams.

Within reason and availability.

Teams are responsible for the equipment.

You sign for it and return it after the course.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Equipment (selection)

Computing

Raspberry Pi 3/4
Raspberry Pi Zero W
ESP32 microcontroller
ESP32 + LoRa
Android phones
Mini-PCs
NVIDIA Jetson

Communication etc.

RFID reader + bacon/card
GPS receiver
Software defined radio receiver
433 MHz simple link kit

Components

Breadboards
Connectors
Passive electronics
Active electronics

Sensors + Actuators

PIR motion sensor
Ultrasonic distance sensor
Temperature sensor
Temperature + humidity sensor
Volatile gas sensor
Sound sensor
Buzzer (active/passive) module
Capacitive touch sensor
LCD character display
Relay switch
Force sensing resistor
Infrared line tracker
Triple axis accelometer + gyro
Capacitive touch switch
Raspberry Pi camera
Servo motor
Stepper motor
RGB LED module
RG LED module
Auto flash LED module
I2S microphone
Laser module
Button module
Tilt-switch module
Mercury switch module
IR receiver module
Reed switch module
Photo interrupter module
Rain detector module
Joystick module
Potentiometer module
Hall switch module
Analog temperature module
Thermistor module
Sound sensor module
Photoresistor module
Flame sensor module
IR remote controller
Rotary encoder module
IR distance module
Pressure sensor module
Real-time clock module
Speakers
Shelly Plug

Additional Resources

Basic electronics workstation

Soldering, lab power supply, oscilloscope, etc.

Basic 3D printing

Prusa i3 MK3, Bambu Lab X1C, basic filaments

Limited resources

If you need them, email us for an appointment

What to do with the equipment?

Each individual piece has limited usefulness,

but the pieces become valuable as a *networked system*.

Big providers build *centralized systems* to which every device connects,

but we want to build the system ourselves by having the *devices communicate directly*.

This is an *advanced* course; we expect you have learned a lot already. This is a chance to put it into action and fill the gaps.

Challenge yourself, try something new and challenging.

(i.e., don't just run PHP+MySQL on a PC and connect to it with a phone's web browser, don't just connect everything to a cloud service, etc.)

Grading

Combination of a **team** and an **individual** grade.

The **process** is evaluated (25%).

Idea creation, implementation, presentations.

The **end result** is evaluated (50%).

Product (demo), documentation, quantitative evaluation.

Individual contributions are evaluated (25%).

Peer evaluation, practical meetings, repository activity, lecture attendance and contributions.

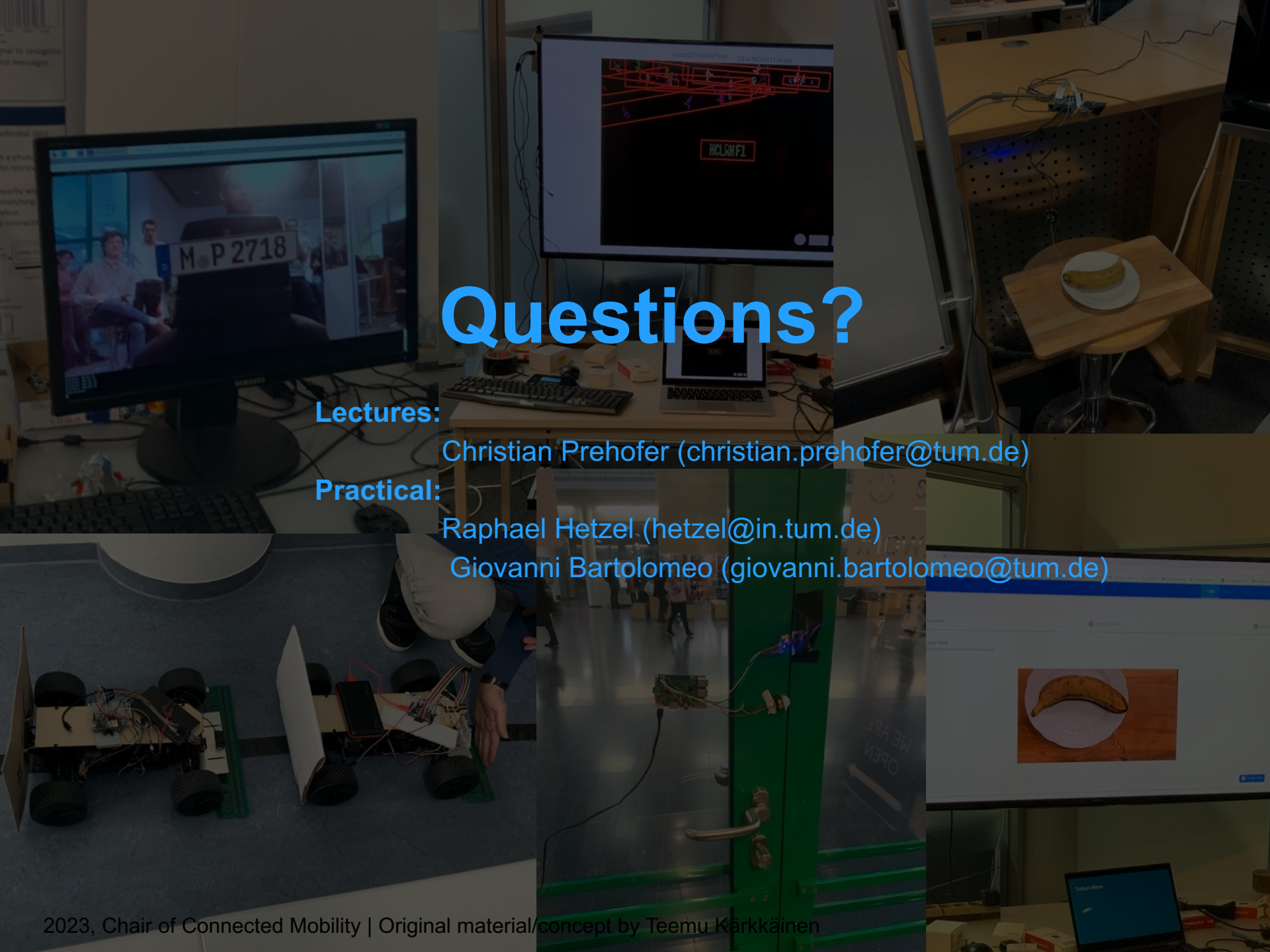
Exercises

Goals:

- Experiment with common IoT equipment
- Experiment with the required tooling and CI systems
- Broaden your horizons and explore new ideas

Exercises (more details on the exercise sheet):
Blink an LED, read sensor values, build a distributed application spanning multiple edge devices, set up a CI pipeline, update your application over the network

Optional; recommended if you don’t have prior experience



Questions?

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2023, Chair of Connected Mobility | Original material/concept by Teemu Kärkkäinen