MOTIVATION

from perspective supervising teachers as early as possible

• involving interested students in engineering and scientific work
• give experiences in application of theoretical knowledge, and complex projects, provide individual learning paths
• encourage to engage with the fundamental skills in depth
• support networking and formation learning groups
• work on projects together with student teams >> very helpful in the development of experimental set-ups for use in teaching
60th ILMENAU SCIENTIFIC COLLOQUIUM
COMPETENCE ORIENTED STUDY IN ENGINEERING EDUCATION - EXAMPLES FROM THE PACTICING PROGRAMME

CHARACTERISTICS AND METHODOLOGY

Figure 1: Implementation of a concrete practicing project from the project catalog

WIND TURBINE MODEL WITH DIGITAL TWIN

Thomas Röckl

Department of Mechanical Engineering „Product and System Development”
Univ.-Prof. Dr.-Ing. Stephan Husung

EXPERIMENTAL BALL DROP TEST ENVIRONMENT

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Department of Computer Science and Automation „Systems and Software Engineering”
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Authors: Sabine Fincke, Ralph Maschotta, Thomas Röckl, Lukas Daubner, Yi-Chun Hsu, Clara-Sophie Roßbach, Lydia-Dorothea Augustin, Jan Deupmann, Marius Lehmann, Anna Maria Treffurth
Objective of the project (11/22 – 04/23)

- Gathering additional efficiency information with sensors for temperature, pressure, windspeed, heading, timestamp
- Implementation of live-feed as digital twin
- Easy to disassemble/repair

Methodology in project processing

- Individual work packages
- Members could focus on strengths
- Meeting with supervisor every 2 weeks
  - Presentation of progress
  - Discussion of ideas & problems

Implemented Solutions: Sensors

- Sensors in many parts “off the shelf” products
- Windspeed-sensor built from existing anemometer

Team: Yi Chun Hsu (MTR 4);
Thomas Röckl (MTR 3);
Clara Roßbach (MB 3);
Supervisor: Prof. Dr. Stephan Husung
WIND TURBINE MODEL WITH DIGITAL TWIN

Implemented Solutions: Mechanics
- Overhaul of electronic boards enclosure
- New motorization by stepper motor and gear system
- Redesign engine pod

Figure 5: New engine pod
Figure 6: Motor and gear system
Figure 7: Electronic boards

Implemented Solutions: Digital Twin
- Data collection on micro-SD-card
- Data transfer via Bluetooth connection
- Visualization in “node-red”

Figure 8: Data collection
Figure 9: Data visualization in “node-red”

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WIND TURBINE MODEL WITH DIGITAL TWIN

Summary

- **Achievements**
  - Optimized data gathering and visualization
  - Better accessibility
  - Optimized construction

- **Individual learnings**
  - Practical experience in 3D printing, programming...
  - Working in a team with
    - Defining work packages
    - Individual responsibility
    - Regular exchange of ideas

Figure 10: Final wind turbine model with digital twin

EXPERIMENTAL BALL DROP TEST

**Objective of the project**

- Build new experiment setup
- Allow easier modification

**Aims of the project**

- The following major and critical components were identified:
  - Base structure and framework,
  - Construction of the turntable and drive thereof,
  - The ball transports,
  - The catching mechanism for the balls,
  - The electrical system,
  - The release mechanism and the ball drop mechanism,
  - Separation of the balls after release,
  - The modularization of the overall setup.

Figure 11: Experiment setup “Ball drop test environment”

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**EXPERIMENTAL BALL DROP TEST**

**Methodology in project processing**

- Five students from courses in computer engineering and mechanical engineering
- Estimated two years until use in teaching

- Processed only first subproject within practICING

Figure 12: Creation of prototypes for the vertical transport of the balls

**Ball movement solutions**

- Archimedian screw
- Horizontal movement
- Magnetic release mechanism

Figure 13: Archimedian screw
Figure 14: Magnetic release mechanism
Figure 15: Horizontal movement

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EXPERIMENTAL BALL DROP TEST

• “Off the shelf” electronics components with few own developments
• Cork for sound dampening
• Two sensors for position and speed observation

Figure 16: Electrical components (left) and top and bottom of the rotary disc (middle and right)

Summary

➢ Experiment setup
  • More reliable setup
  • Less audible distraction for neighbouring rooms

➢ Personal benefits
  • Gained skills in presentation
  • Improved working in bigger groups
  • Learned using CAD and circuit design

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MOTIVATION FOR PARTICIPATING

Figure 17: Motivation for participation in the practicING offers

PARTICULARLY EXCITING

Figure 18: Responses regarding particularly useful experiences

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WHAT WAS THE BEST THING?

- Insight into different areas (programming, coordination of people, electrical engineering, interaction of components, 3D printing, work in the specialized areas, professional writing,...),
- I really liked the practical work or the practical reference | The workshops and additional offers were particularly successful | Essential skills for engineers are tackled right at the beginning: CAD, manual work (soldering, turning, milling, filing, drilling, etc.), programming (microcontroller),
- Getting a good feeling for what it means to be an engineer and what requirements you should be able to handle,

- Receiving constructive criticism from people with special expertise (e.g. in the creation of operating instructions),
- The opportunity to go into workshops and manufacture the components yourself, gaining experience around 3D printing,
- Good practical supplement to theoretical basics from the early semesters,
- Start right away with your own design work as part of the practical project: Learning by doing,
- Direct close cooperation also with professors

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EXPERIENCES SO FAR

• The students can use the practicING offers to develop specific engineering competencies. Individual learning paths are supported.

• Important conditions for success are:
  • available time slots for common project work and supplementary learning opportunities
  • individually oriented supervision of students and project teams by staff and supportive student tutors

„Have the courage to do things differently.“ (R. Messner)