



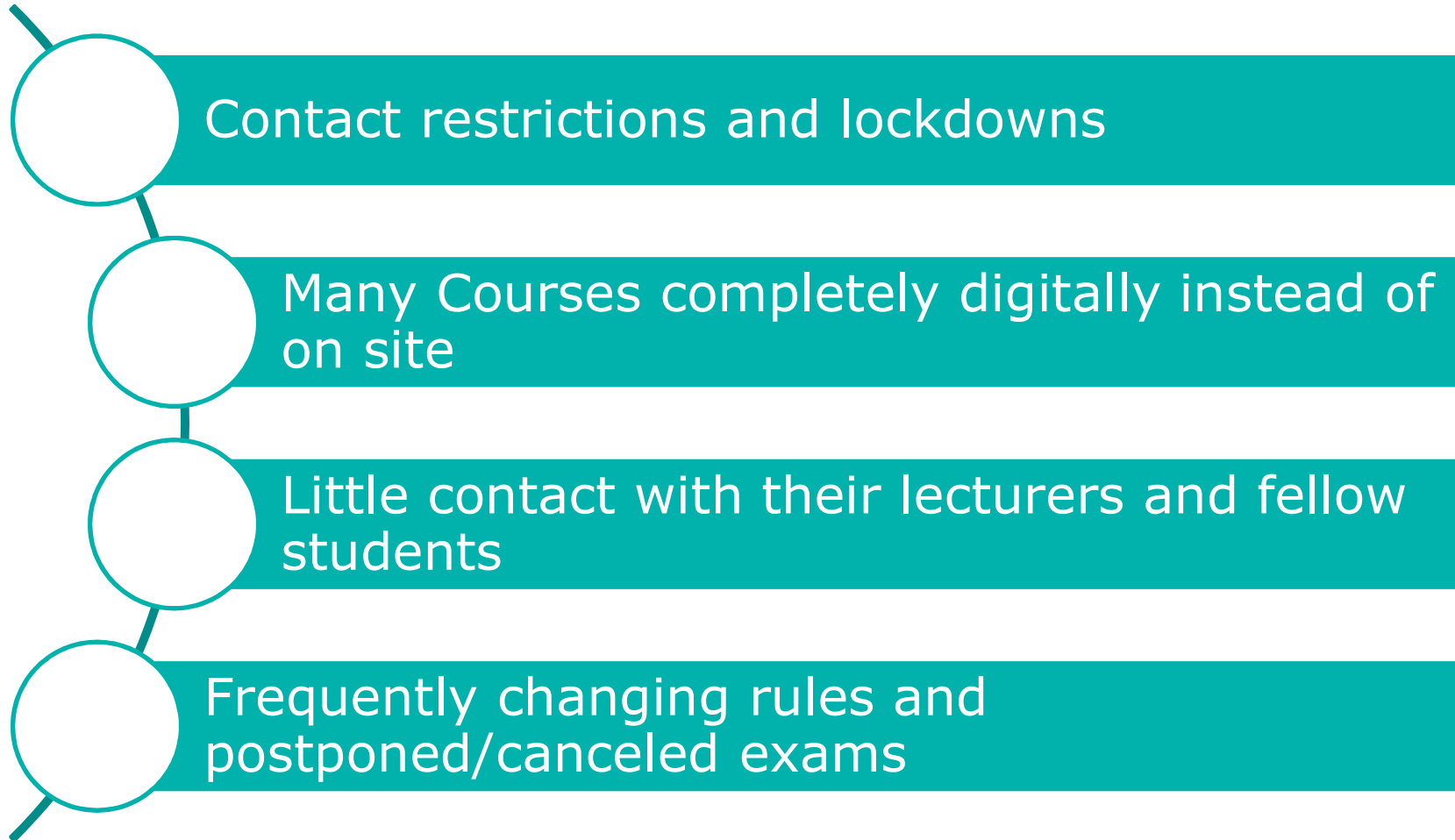
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Practical engineering theses under pandemic conditions: challenges and new approaches



Situation of students in pandemic





Consequences for students

These changes because of pandemic situation lead to several consequences for the students:

- Loneliness
- Hardly know their fellow students
- No normal everyday life at the university
- Uncertainty, poor planning and a lack of prospects
- Problems of motivation and self-organisation
- Financial problems, since many part-time jobs, e.g. in gastronomy, disappeared because of business closures and lockdowns



Special situation graduation

Bachelor and Master Theses are important elements at the end of engineering studies.



By independently working on a practical topic, the students should prove that they have learned all necessary tools to deal independently with typical problems in a given time frame.



The final thesis also accounts for a large proportion of the overall final grade.



The thesis often is a topic in job interviews with graduates when they start their career.



Special situation graduation

Many students ask themselves whether it makes more sense to complete their studies somehow and struggle with an uncertain job market with application problems, or whether they should study longer and hope for better times after the pandemic.

They suffer from this disorientation and the universities often do not know exactly how to proceed as well.





Graduation at university

Procurement of literature is made more difficult by partially closed libraries.

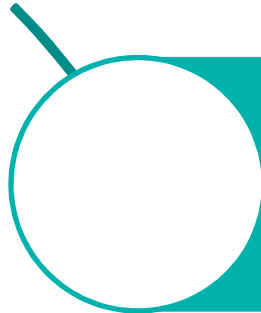
Access to laboratories, workshops or test stands at the universities is severely restricted.

Many students have great difficulties to even find a suitable topic for a thesis.

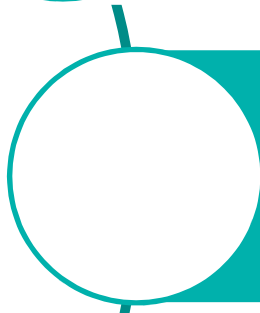
Many research projects are delayed because the scientific staff work in the home office and can hardly carry out experiments.



Graduation in industry



Theses in industry are hardly supervised or not offered at all due to the home office activities of the employees.



Financial bottlenecks in companies because of short-time work.



Poor ability to plan due to the pandemic plays an important role as well, since many companies find it difficult to agree to supervise a thesis for a period of several months.



Making the best of it...

Since it can't be foreseen when normal operation at the universities will be possible again in the long term and in a predictable manner, new concepts were tried out. It was stuck to the general concept:

- Students were given real questions as a topic for a thesis e.g. from ongoing research and development projects.
- Industrial projects were supported also as far as possible under the changed conditions by the university.
- Companies were encouraged to provide topics despite uncertain times.

50 Staying in contact digitally

Each individual student has a regular digital meeting with the supervising professor and the scientific staff or industrial partner:

- Questions can be directly asked, answered and discussed. → At least a certain professional exchange is possible.
- Also creates a certain commitment when the students have to present their progress briefly every week.
- It helps the students to organize themselves if there were still fixed appointments in the digital sphere despite the lockdown.



Working on completely from home

In the case of planning and conception topics, this was possible without any major problems as long as the technical equipment (PC, software, Internet access, etc.) was available.

Other practical questions had to be modified in such a way that they could be worked on from home as far as possible.

If that was not possible either, individual projects were not implemented actually, but analyzed using appropriate simulations.



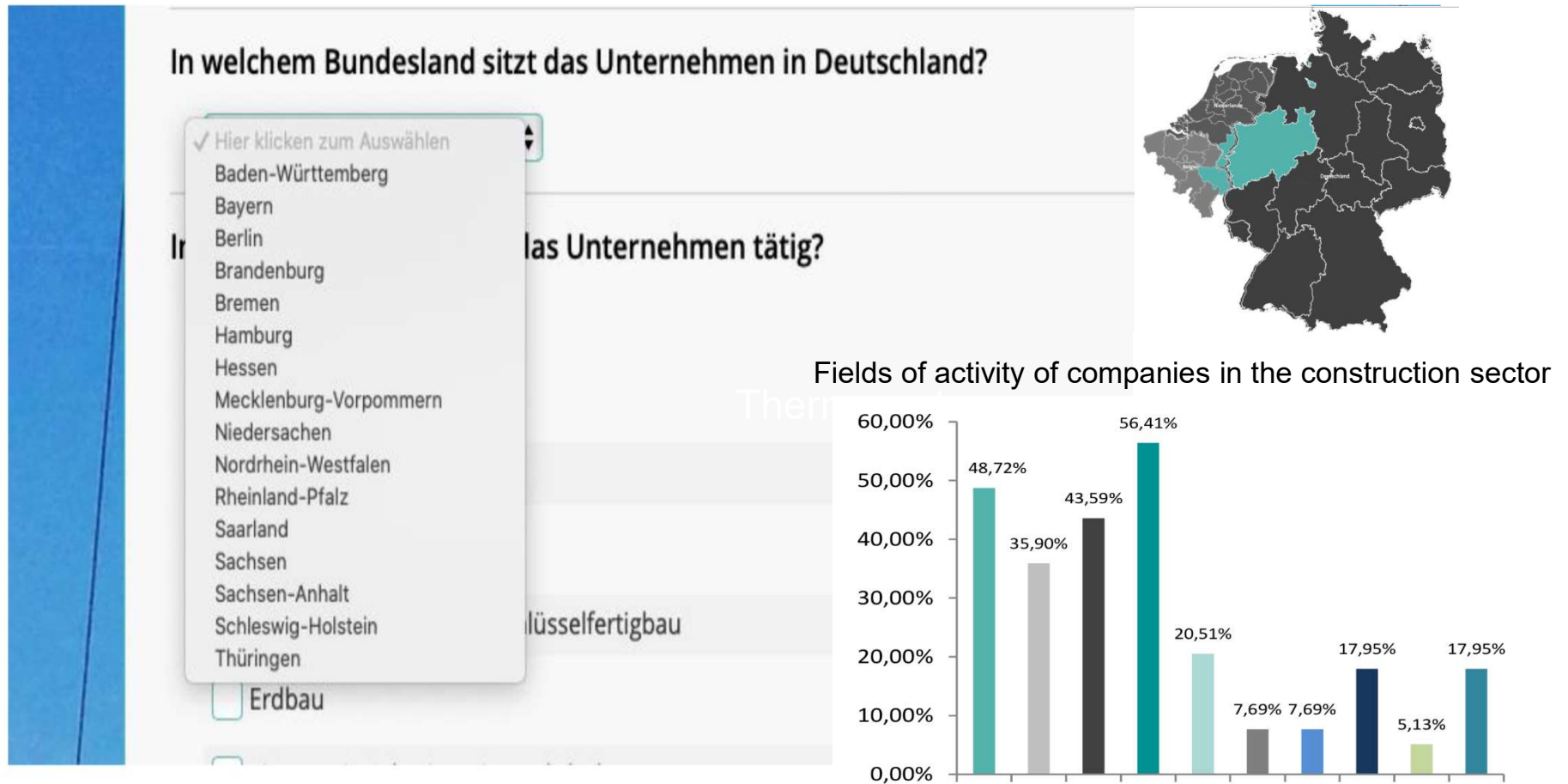
“Strategies and measures to strengthen the interregional construction industry”

Even a thesis, for which research was carried out with various industrial partners, could be carried out completely digitally with little additional effort:

The request to the industrial partners was made by email and by telephone. Since the interviews that were actually planned on site could not be carried out and arranging appointments with the employees in the home office also was more difficult as usual, a questionnaire was developed. The industrial partners surveyed were able to respond at any time when it suited them.



“Strategies and measures to strengthen the interregional construction industry”



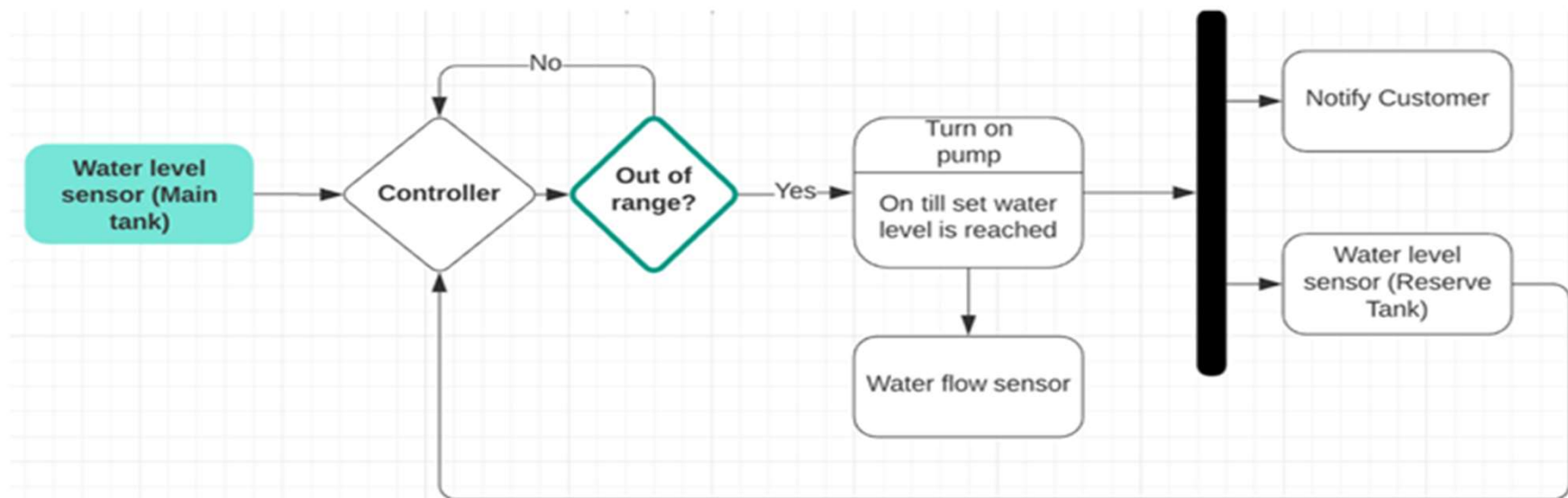
Online questionnaire, own representation by Felix Brunner, FH Aachen

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“New Automation for Smart Salt-Sweetwater Aquariums”

Since laboratories and workshops were not available, in some cases, students could borrow the parts they needed and take them home to work on the projects.

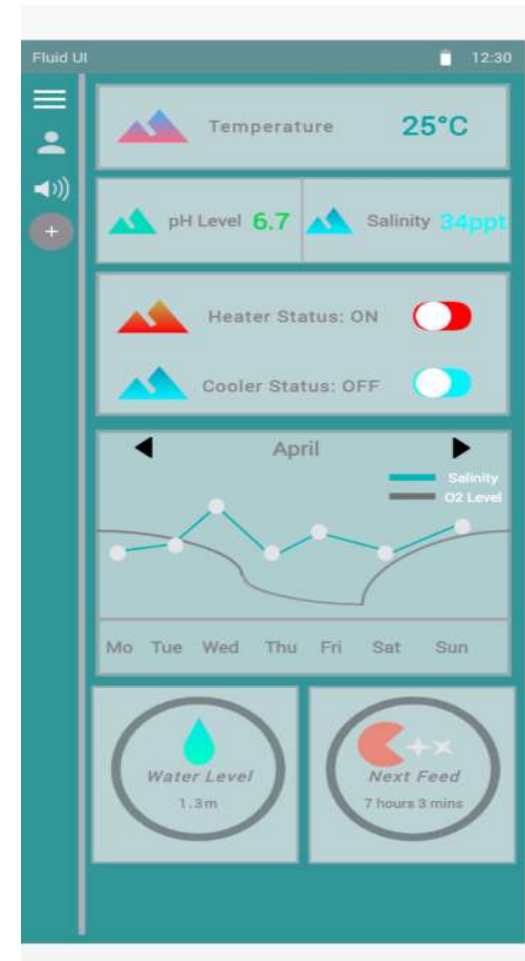
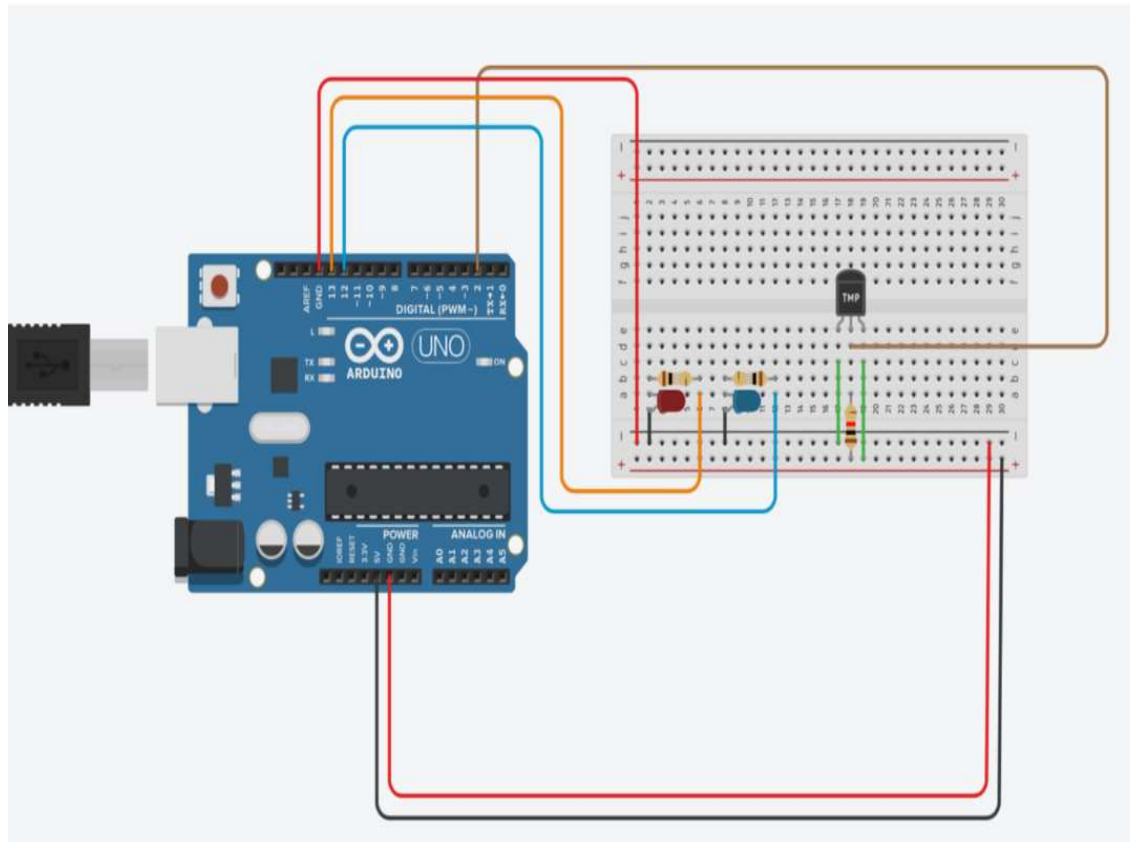
Programming a microcontroller like Arduino could be done from home without any problems.



Flowchart of regulation, own representation by Joseph Akle, FH Aachen



“New Automation for Smart Salt-Sweetwater Aquariums”



Wiring diagram and App design, own representation by Joseph Akle, FH Aachen



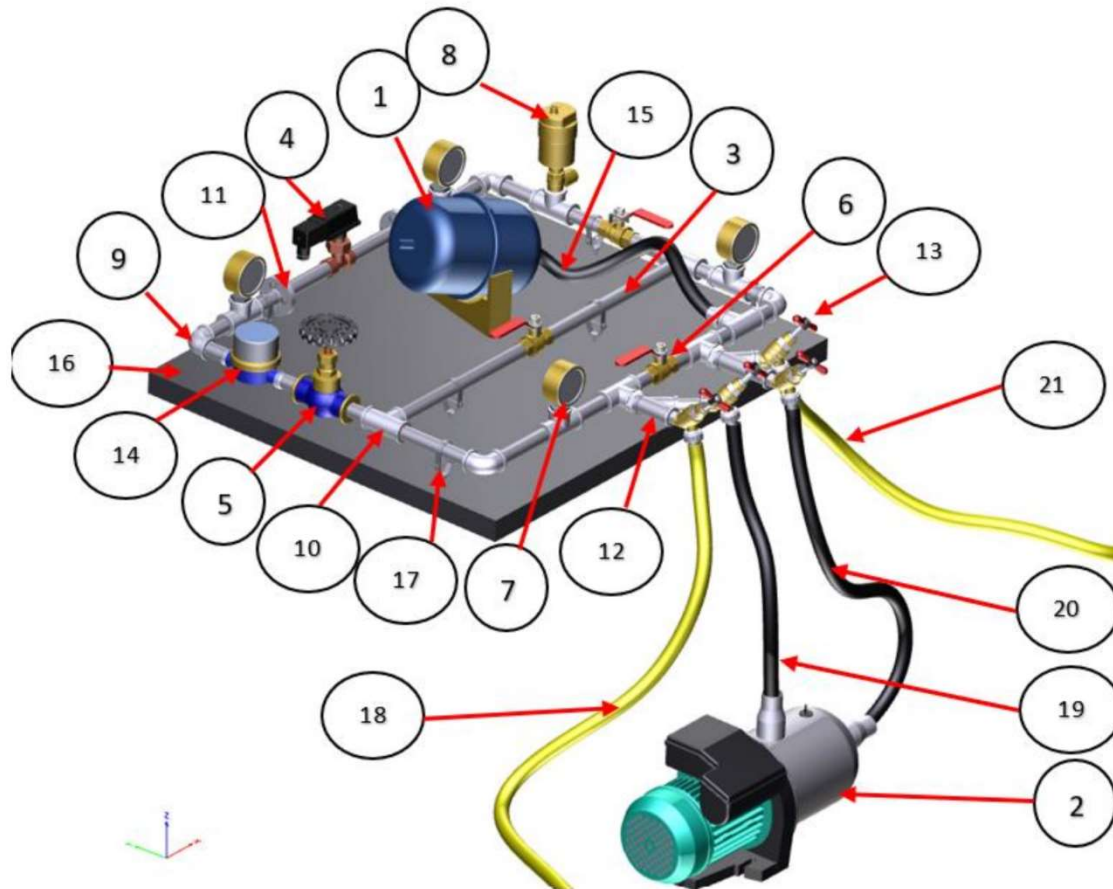
“Experimental Analysis of the Operation of a Paddle Disturbance Monitor”

Projects with larger individual parts the individual components had to be assembled in such a way that assembly at home is possible with simple tools. Then the assembly was started in such segments that the complete system could later be assembled quickly in a test hall in order to carry out the measurements.

This required completely new aspects in the conception of the system (transportability, easy assembling procedure) and a certain technical talent on the part of the students.



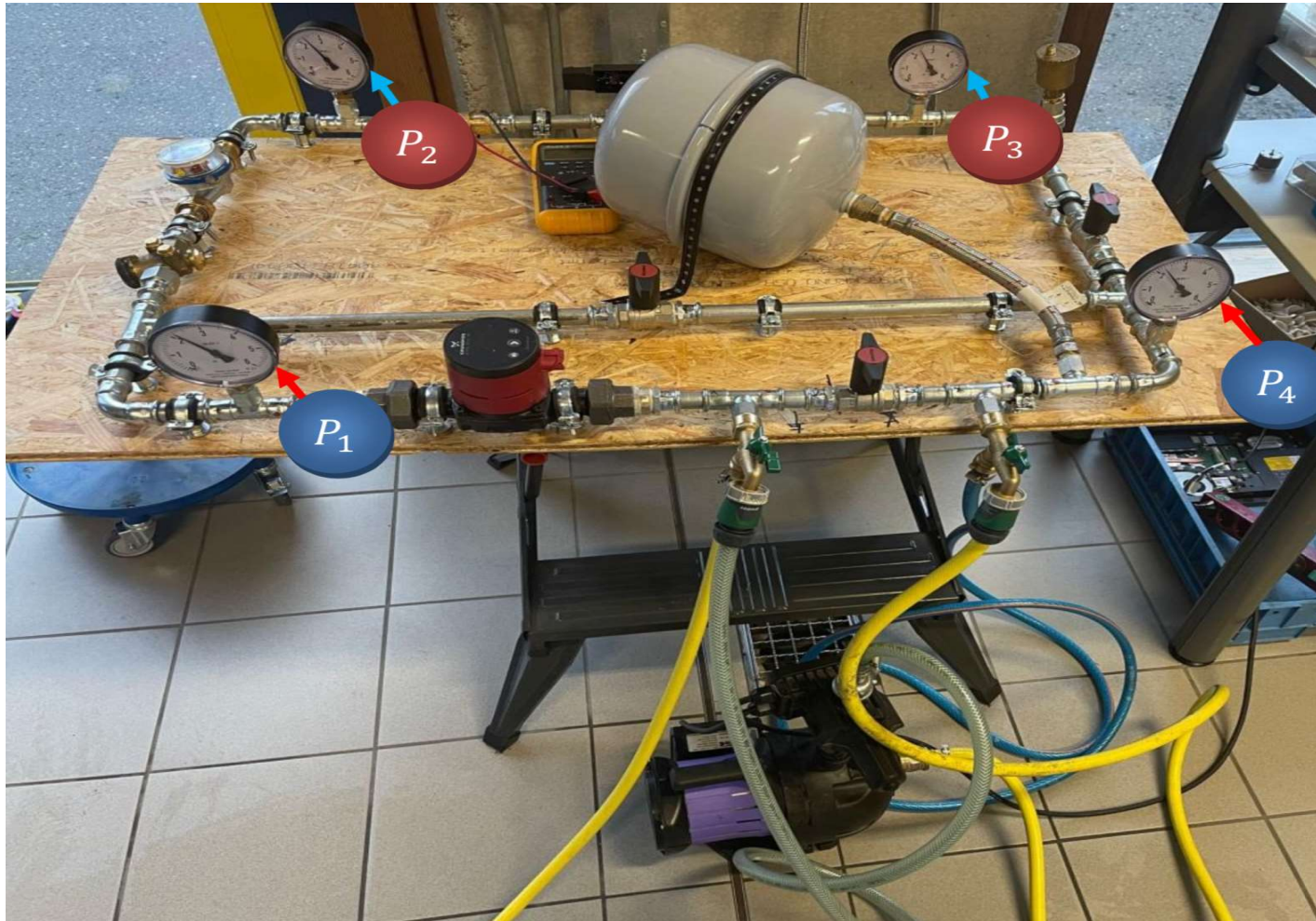
“Experimental Analysis of the Operation of a Paddle Disturbance Monitor”



Number	Name
1	Expansion tank
2	Centrifugal pump
3	Galvanized steel Pipes DN 20
4	Alre JSW ½" FS
5	Control valve
6	Ball valve
7	Manometer
8	Air vent valve
9	90° Elbow
10	T-joint
11	Flange bolts
12	Y-joints
13	Tap Valves
14	Water meter
15	Plastic hose
16	Support plate
17	Pipe anchor support
18	Open system entry hose
19	Closed system entry hose
20	Open system exit hose
21	Open system exit hose

3D-Model and part list, own representation by Mohamad Shbaklo, FH Aachen

“Experimental Analysis of the Operation of a Paddle Disturbance Monitor”



Assembled test rig, own representation by Mohamad Shbaklo, FH Aachen

50 Conclusion

In most cases, the implementation was a success: The students



- were happy to be able to successfully complete their studies without any further loss of time or financial problems.
- saw it as an opportunity to adapt a project to the actual conditions and make some progress instead of waiting for the pandemic to end.
- have learned a lot about problem-solving strategies, which is an important skill for aspiring engineers who will have to react to changing frame conditions in ongoing projects in their future professional careers.

50 Outlook

The involved companies and industrial partners were pleasantly surprised by the often new and very creative solutions and remote support for the projects.

Many interesting ideas for future projects and theses have emerged, which also include e.g. newly acquired distant industrial partners who urgently need new engineers used to project management.

These extra skills and fresh experiences will definitely pay off for both employers and young professionals or start-up founders as well.

