Revised Distillation Column Laboratory Offers New Opportunities for Automation Education in Tampere3 Universities

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EXTENDED ABSTRACT

The evolution of automation calls for up-to-date education. An automation system contains modern information and telecommunications technology, and intelligence is built in nearly all devices. The students of the field must not only adopt the latest technology but also master legacy systems.

Tampere University of Technology (TUT) has a distillation column in research and education use. The actual process involves a closed circulation where the compound of water and ethanol is being distilled. The process has several controlled variables and complex interactions between them. The hardware of the distillation column is more than 30 years old, while the automation system around it has evolved over the years. This paper describes the latest reform of the automation system, where particular attention was paid to modern educational use.

In the modernization project, the automation system in its entirety was revised. All equipment and software were replaced, and also some of the field devices were changed. On the other hand, some of the older field devices remained. Thus, also legacy technology is introduced to the students. Not all equipment in real-life industrial processes is most modern.

The reform aimed at meeting educational needs in particular. The examples of this include measurement circuits that can be easily disconnected from the connection strip, thus enabling easy testing of the analog signal. Process control is distributed to two process stations. Components familiar from industrial systems were introduced, such as a separate field box where measurement connections are assembled. The system comprises all components relevant to process automation distributed as in a real automation system.

The new distillation column environment serves the automation education of TUT at several levels. At the first level, first year students study the equipment with the power turned off. The task could be, for example, finding given devices with the help of the process chart. Augmented reality creates new opportunities: a mobile application could give additional information on the device currently in the picture.

At the second level, the power of the automation system is turned on but the process is only running cold. The students see flow control loops in action and learn how a controller works. At the third level, the students are allowed to configure controllers, still with the cold process however. Finally, master level students advance to the fourth level, where they heat up the process and get to control the distillation.

In addition to the education of TUT, these reforms and new features benefit Tampere3 projects. The goal of Tampere3 is to integrate Tampere University of Technology, Tampere University, and Tampere University of Applied Sciences (TAMK) into one university. Reforms make new kind of collaboration between TUT and TAMK automation education possible. Virtualization and solid laboratory network connecting these two universities together safely offers possibilities to design new teaching materials and exercises for students in both universities - without significant investments.

Cooperation in automation education between TUT and TAMK has been discussed in Control3 workgroup which consists of automation teachers from both universities. Control3 discusses the possibilities Tampere3 collaboration offers for both automation engineering educations. There are some similarities in control theory education in both universities and some of it can be implemented together in the future. However, the main opportunity lies in the laboratories of both universities. TAMK has good student laboratories, for example, for teaching PLC programming. In addition, they have good equipment for teaching automation technological principles, such as control theory and measurement technology. On the other hand, TUT has more complex learning environments, such as distillation column, headbox process and batch control process with distributed control systems.

Collaboration started in autumn term 2016 when 17 students from TAMK were invited to visit the distillation column laboratory. Students spent one day at TUT and worked with the column: the process was started up, controlled and shut down. In addition, students access field devices and determine the structure of control system and control application. The idea was to get to know the process as a whole. From discussions in a laboratory and reports students wrote afterwards the day seems to be rewarding. Students liked this kind of learning opportunity and said that this exercise concretize many issues they have learned previously during their studies.