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Thanks to Bachelor Thesis to Technical Innovation

Imagine the following: Printed products – they may be different or they may all be the same – run along a conveyor track. There is no barcode or other identification printed on them that could be scanned to tell us which product it is. So how can I track and trace these printed products on any given conveyor route using the most cost-effective system possible?

This was an interesting and challenging problem that had been occupying us in the development department at Muller Martini for some time. Since it was not an urgent customer request and we did not need a timely solution, this seemed to me to be an ideal topic for a bachelor thesis. From my many years of experience as a supervisor of student research projects, Bachelor's and Master's theses, which we carry out together with universities, I know that this is an important criterion for assigning topics.

Time pressure is an unfavorable precondition. After all, it can take up to six months for a thesis to produce an initial result. And the solution presented is then often far from ready for the market, since the students lack not only time but also practical experience in product development, such as knowledge of cost optimization, manufacturing processes or synergies with existing products.

Teamwork

With the above-mentioned project, we turned to the [University of Applied Sciences and Arts Northwestern Switzerland \(FHNW\)](#), which advertised the topic as a bachelor's thesis. At the

University of Applied Sciences and Arts there, an estimated 95 percent of final theses have a project context with industry partners. Students can apply for a task and are assigned via a matching algorithm. In our project, called „Optical Product Tracking,“ computer science student Mike Nöthiger was matched with another computer scientist, Marco Waldmeier, and systems engineer Dominik Gremaud. „It was a stroke of luck for us, because this way we not only had the IT and programming know-how on board for solving the problem, but also the knowledge about the technical setup of the equipment,“ Mike Nöthiger commented on the decision.

As far as the success factors for a good bachelor's thesis that also brings high benefits to the industry partner are concerned, I agree with Professor Dr. Christoph Stamm, Head of Research at the Institute of Mobile and Distributed Systems and Lecturer for Computer Science at the FHNW. „For a well-functioning collaboration, it is important that the industry partner puts its wishes and requirements in writing as precisely as possible and keeps the requirements consistent for the majority of the project duration. The more precisely the task is formulated, the faster the students can start the actual work,“ the technical coach of our project explained to me in our conversation.

The close and continuous support of the students by the industrial partner and the lecturer is an important aspect that should not be underestimated. The participating company must plan time and resources for this. But the effort is definitely worthwhile in order to ultimately achieve informative and usable results. And another tip from Mike Nöthiger for all students who are also planning a thesis with an industrial partner: „It was crucial for our success that we met regularly every two weeks – mostly online due to Corona – with all those involved to discuss the progress of our work. This way, we knew in a timely manner if the work progress was in line with the stakeholders' expectations and could adjust our solution.“ I myself tried to get as much out of the way as possible and support the students so that they could focus on their actual task. This included allowing them to set up their sensors on our test facility at regular intervals and test their new programs in a real environment for a day. With these results, the students then went home to refine their programming and polish their algorithms.

Success rate was 100 percent

Perhaps you would be interested to know at this point how the task was solved? The first step was to evaluate the appropriate hardware, as cameras, microcontrollers, light source and mounting material. A big challenge in this project was to keep the costs as low as possible and still produce good quality images or video data. In a second step, algorithms were evaluated and, in this case, developed in-house, which further processed the stored images and videos according to the requirements.

„First, it was a matter of installing the hardware and ensuring robust communication between the cameras. Next, a computer application had to be developed that could be used to control the cameras remotely from a central location. The tricky task of this development work was to ensure that the products were correctly recognized in the video stream, because we were particularly concerned about the sometimes low contrast between the background and the product. That was really tricky,“ Mike Nöthiger told me. In the end, the students used the background subtraction method, a software solution that covered the basic requirements very well: every single book can be tracked on the conveyor belt. Individual books can be temporarily removed and put back later without disturbing the algorithm. Here, the system's success rate was 100 percent.

This was also the case at the final presentation of the work, which took place at our head-quarter in Zofingen. At the beginning, the three students gave a live demonstration of the

system on the test track. In the process, it had to meet the requirements set. Afterwards, the results of the bachelor thesis were presented and discussed in detail. Professor Dr. Stamm was particularly pleased that other Muller Martini employees were present at the demonstration: „The interest and critical appraisal of the results by the client is a great motivation and confirmation for the students.“

A win-win situation for both sides

The cooperation between industry and university results in interesting new inputs for both sides. In addition to the development of a functional model, as in the case described, the tasks can be of a very different nature. We have also had purely basic work, in which mainly research was carried out and variants had to be evaluated. If it's a proof of concept, existing software or mechanics are tested to see whether the development can be used. And in the case of implementation work, the students have to build and test a subsystem based on preceding work results. At Muller Martini, we were able to directly use the results of this very good bachelor thesis. Although we do not yet have a system that is ready for sale, the results will definitely flow into our innovation process. In other words, a win-win situation for both sides.

Finally, I would like to mention another advantage for our company. With such a cooperation, we also increase the awareness of our company as an interesting employer among students and thus future potential employees. This should not be underestimated, because on several occasions young, highly motivated people have found their way into our teams in this way. And that always pleases me personally the most.

Yours,

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