How a robot equipped with control technology from Austria skillfully masters bricklaying work in the Netherlands

Tireless **Brick Shovel**

The shortage of skilled workers is also a glaring problem in the construction industry. Qualified bricklayers are hard to come by - in Austria as well as in the Netherlands. The local company Ropax took up the idea of using robotics for bricklaying and developed the mobile bricklaying robot "Pax". This performs its "work" under the harsh environmental conditions on site and can be used very flexibly in the process. This is made possible by the robust technology used - the complex automation tasks are controlled by the "S-Dias" system from the Salzburg-based manufacturer Sigmatek, which is ideally suited for this purpose thanks to its compact hardware, modular software and object-oriented programming. The Dutch Sigmatek solution partner Sigmacontrol provided support for the tricky application creation.

By Tina Streitberger

Ropax, based in Hedel (NL), is a young company specializing in the development of construction robots. The focus is on the automation of masonry work. Project "Pax" was developed by Ropax company founders Jelle Overtoom and Jeroen-Bas Menschaar and Colin Gort, commercial director at Ropax. Overtoom looks back at the beginnings : "When I wanted to go in this direction, the housing shortage wasn't as big an issue as it is today. But it was well known in the industry that more bricklayers were retiring than new ones were coming in. And that in the Netherlands, like many in Europe, we want to live in a small house with a brick facade," he says with a laugh. After thorough market research, this realization solidified: "The solution was to utilize the specialized knowledge of the various craftsmen and skilled workers as much as possible." The result is the masonry robot "Pax". In the past, there have already been initiatives to develop such a machine. However, these have so far failed on a technical level or also due to a lack of investment. Colin Gort explains the concept that will make Ropax's solution successful: "The "Pax" consists of a mobile base with a robotic arm that can independently pull up a brick wall in a fixed

Jelle Overtoom (left) and Colin Gort from the Dutch manufacturer Ropax at their compact, mobile "Pax" robot are convinced that they have chosen the right partner in Sigmatek.

location." What sounds simple has caused quite a few headaches during development: "If we all wanted to live in a bungalow, it would be easy, but the reality is different. Firstly, everyone wants their own individual design and secondly, every construction site is also different. There are always things that you can't predict. Meanwhile, a deciding factor is that we can adapt to the site, not the other way around."

Jelle Overtoom adds: "We had tested the idea of laying bricks quite quickly, but this still required the production of a special substance. The mortar should be pumpable, have low resistance, be stable and have a long working time. In addition, other factors on the construction site must be carefully considered."

Challenges on the Construction Site

Probably the biggest challenge for the developers was to convert the work of a specialist on the construction site into an automatic process. A bricklayer often estimates by eye, but a robot must have such estimates, such as tolerances and size differences, programmed into it in advance. For that, you need the right software. "It's about automating a repetitive process, but that's difficult when circumstances are constantly changing. Take something as simple as a brick and think about hardness, differences in shape, or depressions appearing in the brick so that more mortar needs to be added to the wall", Jelle Overtoom outlines the complexity.

Insight into the "Pax" masonry robot: at the bottom left is the sawing unit, next to it the robot that lays bricks as well as applies mortar, on the right the cement pumping unit and the mortar supply hose.

After all requirements were met and corresponding prototypes were tested, the first customer was finally won. "From that moment the development went pretty fast", Colin Gort remembers. "Now it is so that the "Pax" can be used immediately. He measures, creates a stone pattern and lays."

The Control is what Counts

Now, to integrate this complexity into a functioning machine, the Sigmatek-S-Dias control acts as the heart of the system, integrating modular sensors and actuators (often combined with other platforms and protocols). The S-Dias automation system offers reliable, precise control in a pocket format and features high mechanical stability and vibration resistance. Safety is also an integral system component: Safety CPU, digital and analog Safety I/Os. In the "Pax" masonry robot, the compact S-Dias system

The control heart of the plant is located directly in the operator station: the compact and robust "S-Dias" automation system from Sigmatek including safety CPU and I/Os.

engineering at all times. All classes of the software can be derived, a derived alarm buffer can e.g. send alarms directly to a database via MQTT.

Outlook

As with most technical applications, the development of the "Pax" masonry robot does not stop with its market launch. Ropax's declared goal is to convince numerous construction companies of the advantages of leaving straight bricklaying entirely to the robot in the future. Jelle Overtoom has a clear vision in this regard: "In Amsterdam, there are buildings that are 400 years old that people from all over the world come to see.

with numerous interfaces ensures smooth operation in the robot control system. The ETT 764 7" multitouch control panel enables smart, intuitive operation. The four processor cores of the powerful EDGE3 technology processor are precisely matched for smooth (web) visualization, contributing to an optimal user experience. The Sigmatek automation package is completed by the all-in-one engineering tool LASAL. For modern mechanical engineering in particular, clearly structured and modular software is a key success factor. LASAL combines object-oriented programming (IEC 61131-3 standard) with graphical representation and thus makes modular, mechatronic enginee-ring possible. Ready-to-use templates and function blocks as well as easy code reuse significantly reduce engineering times.

The Realization

The "Pax" machine consists of a robot arm that receives direct instructions from the PLC via a VARAN EtherCAT coupling module VBC 121, a cement pump, a stone feeder, a sawing machine, a nose wheel, a separate laser positioning unit, the WiFi communication module RAR 2415. Jelle Overtoom sees a major advantage of the control and automati-on technology from Sigmatek in the simple handling: "Both on the software side with the LASAL libraries and on the hardware side, the I/O connection is done in no time at all. We have a sensor that connects to the Remote

right: A highlight of the masonry robot solution is the pumpable mortar, which also enables a relatively long processing time.

The gripper tool of the "Pax" robot is used for several functions at once: Pre-cutting bricks, positioning them and connecting them with mortar.

The brick is timeless, as long as you build something beautiful with it. My most idealistic idea would be to handle simple masonry work with a robot. In this way, the bricklayer can bring his expertise to more challenging projects."

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Access Router RAR via WiFi - to configure this, I only had to enter the IP address. The modular design is generally very convenient. The robot arm, for example, is easily configu-red via the VARAN EtherCAT bus coupler integrated with the LASAL software." The machine builder has full control over all