

# New robotic stacker system from AIC

*AIC Group is an international company based in Italy and Germany with subsidiaries in several locations. The company has a deep know how in the metals industry and applications in more than 60 countries. This article describes the development and installation of a robotic stacker for a profile rolling mill in Italy.*

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## ROBOTICS SOLUTIONS EXPERTISE

AIC has a robotics department that designs and creates versatile, tailor-made solutions to ensure an advanced process in the finishing area of the processing line, improving the often-harsh conditions in which our customers operate. Robotic applications designed by AIC automatically apply tags and supports to semi-finished or finished metal long and flat products.

AIC offers:

- **Anthropomorphic robots:** models are made specifically for foundries and are designed to work in harsh environments and be multi-functional. The robots can be floor-mounted, or ceiling-mounted and can be integrated into new layouts or in existing ones. An anthropomorphic AIC robot typically has six degrees of freedom and a wrist load of up to 40kg. At the core, the components we use are the best on the market, relying on renowned robotic hardware industry leaders.
- **AI and 3D vision systems:** AIC's 3D vision system is made up of a dual-camera system that is specifically designed for hazardous, or hot environments. This system can recreate the 3D profile of the product simply for example by taking a picture of the bundle on the conveyor. The 3D vision system can automatically detect the type of products without any specific settings.
- **Control units and safety PLC:** both the PLC program software and the control unit of the robotic application can be based on and developed using Siemens, or Rockwell Automation components. Because of this flexibility, the user can implement a stand-alone station with a small CPU or integrate the system into a plant CPU.
- **Tags, QR readers and marking tools:** labels could be used both to indicate quality and for tracking. A fully integrated →

tracking system with GPS options for geo-localization, data collection, database software that is linked to the plant's main system and remote controls to provide enhanced traceability.

- **Metal support and welding machines:** the metal support keeps the printed tag away from the semi-finished or finished products where the material temperature is still high.

This expertise has enabled AIC to develop the first Robotic Stacker, awarded by a major Italian steel producer (Acciaierie Venete).

## ROBOTIC STACKER

AIC carried out the revamping of the automation part for the entirety of the advanced processing lines, located downstream of the cooling bed of the profile rolling mill. The work included



Fig 1 Robots working in pairs



**Fig 2** All four robots working together

the complete automation of the system and the insertion of a robotic stacker divided into four anthropomorphic robots from KUKA. The system processes small L type merchant bars and flat profiles, and allows for expansion of the product range, mainly with angles from 25 x 25mm to 60 x 60mm in size and widths from 3 to 7mm. The project was developed with 3D simulation to verify cycles and interferences with existing machines.

The end tool of the Robotic Stacker was studied and designed by AIC, and this is equipped with electromagnets and interchangeable profile alignment combs. With this tool the system can handle from 1 to 6 bars each cycle. The system makes it possible to neatly stack steel profiles from 4.5 to 13 meters in length. A single robot can handle a product from 4.5m to 6m, it is also possible to have two robots working per layer, as well as to stack two parallel layers (*Figure 1*). Single-layer processing with three robots is possible for products from 6 to 8.5m while keeping one robot stationary for energy saving. Between 8.5 to 13m all four robots can work synchronized together (*Figures 2*). It is possible to do single stacking with four robots, or double stacking with robots used in pairs. The system is also able to operate without one of the four robots.

A special feature of the system is that it is able to shift from one profile to another: the set-up of the machine is very simple and fast to change. In seven minutes a single operator is able to re-equip the robot for a new profile. The system is very flexible, and depending on requirements it is possible to stack from above and below the profiles or alternatively to stack it in a mixed way. This flexibility is useful to reduce stacking cycle times and to form tidier packs.

AIC has integrated the bar stackers into the existing structure to allow the robot to pick up the layers in both straight and in reverse. In order to prevent mechanical modification of the existing machine, the bar stackers were designed independently in the electrical axis. The robotic solution chosen by the customer made it possible to reuse the existing plant in its entirety with only the integration of the robots for the formation of the unprocessed profile bundles. The addition of bar stackers allowed for reverse layer collection without invasive modifications. This allowed the project to be completed during just six weeks of downtime.

For this project, AIC installed an automation PLC and an integrated safety PLC on a Rockwell platform, with supervision plus an ignition recipe book. AIC also participated in the design of the electrical cabinet layout. All the drives are



Fig 3 User interface screen

ABB, interfaced to the plc with an ethernet IP network, all the nodes are aimed at optimizing the plant installation, furthermore, local boxes were used to control the machines for man-machine interface with ethernet IP nodes. The user screen is shown in *Figure 3*.

The control software, specifically developed for the Rockwell-S PLC, manages not only the advanced processing lines, but also the sequences of the robotic stacker, ABB drives, the profile pick-up magnets, a new straightener, both packers (the classical and the robotic one), two binding machines, the weighing system and the pack evacuation part.

The project was originally designed to make angular products (*Figure 4*), but after seeing the reliability of the system, AIC made some adjustments so that the machine could also be used for flat products that were not part of the original plan. The system is particularly flexible in handling different processed products, the stacker can switch between flat and angular products, and there is no need to reprogram the robot to change processes. By using complex control algorithms, the system monitors the picking and depositing of the correct layer of bars and stops automatically if it detects any anomalies. Depending on the stacking recipe, the robot automatically and dynamically adapts to pick up and deposit the various layers.

This system requires rare and limited maintenance apart from an annual overhaul. This is a clear advantage over most stackers that have complex mechanical components and require extensive and constant maintenance. The stacking phase can be interrupted several



Fig 4 The system was originally designed for angular products

times by the operator where an intervention is required, at which point the system memorizes the stage it has reached and when work resumes the process starts again from where it left without the need to reset the cycle. In the event of a magnet, or on-board accessory failure, the system is guaranteed to be replaced and restarted and the robots can also be controlled manually in case tests need to be carried out.

This system makes tidier packs than in traditional stacking and it also has a very low energy consumption; in fact, all drives are regenerative so that the recovered energy is used when it would normally be lost. The power of the magnets is also modulated according to the size of the product for the sake of energy savings. →

The solution optimizes the workflow, reduces downtime and improves the quality of the finished product, but most importantly productivity is optimized to 30 tons per hour and the cycle per layer stays under 10 seconds.

### ABOUT AIC

Since 1975, Automazioni Industriali Capitanio (AIC) has been designing, manufacturing and installing industrial automation systems worldwide, plus mechatronics solutions for the steel industry. Tailored automation is the motto of the company and explains the deep commitment of the AIC team in looking for the best solution for each project in cooperation with their customers and partners.

AIC handles several areas of the production route:

- **Electrical and automation:** AIC covers complete electrical and automation components in melt-shops, baghouses, continuous casting machines, billet/bloom reheating furnaces, and rolling mills for long products such as bar, wire rod, SBQ, section and rail. AIC also supplies and manufactures AC&DC drive cabinets to improve power controls of each machine using all market components according to customers' needs and requirements. AIC also takes care of the revamping of existing plants, assembly of special cabinets and MCC switchboards.
- **AIC is able to implement the different levels of automation:** Level 1 for PLC control, HMI SCADA for the supervision of the plants, level 2 for data management and advanced package for production and maintenance control and interface with upper levels.
- **Special machines:** AIC has long experience in the production and assembly of wire tying and strapping machines. Tying machines are designed, produced and assembled by our Italian unit, ATS Mechatronics in Udine (Northern Italy). These kind of solutions allow the automatic tying of wire bundles, sub-bundles and packs, which are then positioned downstream of the product formation area, before moving to the discharge area for tagging and final storage. The range of bundles varies from 50mm diameter up to packs of 1100 x 1100mm. The ATS portfolio includes plastic

and steel strapping machines for the metal products. The latest machines developed by ATS are vertical and horizontal compactor and tying machines for wire rod and bar-in-coil products, in both hot and cold areas.

- **Plant digitalization:** The 4.0/5.0 transition is centered on digital transformation. Analyzing and working on daily data in real-time is critical for making production processes more fluid and agile, ensuring quality by freeing up valuable time for other strategic activities, and promoting predictive and effective maintenance through plant equipment connectivity. AIC has the competencies to implement systems that allow the management and scheduling of production, tracking and level 2 systems, registration of alarms and events, management of recipes and the roll shop. AIC implements "virtualization" systems that enhance the utilization of hardware resources, resulting in significant cost savings, simplified management, and easy system updates. It also fits the needs of the process, which remains consistent over time thanks to a physical server that runs and manages multiple virtual servers, each of which operates as an isolated server.
- **Safety systems:** Full integration into the main automation plant is key to winning the challenge of safety conditions without risk and loss of efficiency. AIC offers safety fences, gate control and safety access with smart control. CE marking, consulting services, hardware (mechanical and electrical) and documentation are all included in one bundle.
- **Lifecycle service:** AIC is committed to lifelong assistance with hardware and software services and process support. AIC also provides remote support to assure maximum flexibility, quick response times and reduced downtime. Furthermore, AIC supplies continuous training and targeted courses for clients. **MS**

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