

TwinCAT Motion Control automates recycling processes

Self-learning robot recycles materials in fully-automated waste sorting facility

With the development of the “ZenRobotics Recycler”, a self-learning robot that reclaims valuable raw materials from the waste stream, Helsinki, Finland-based ZenRobotics Ltd is well on its way to revolutionizing the recycling industry. The system replaces the traditional manual labor during the sorting process and can profitably collect materials for recycling which were previously considered uneconomical. The improved separation of materials provides additional benefits, as recyclers now receive better prices for them. The system is controlled by an Embedded PC that runs the TwinCAT automation software platform.



The recycling system from ZenRobotics uses self-learning robots to separate recyclable materials from the waste stream with high speed and efficiency.



Juha Koivisto, Project Manager at ZenRobotics

The ZenRobotics Recycler (ZRR) is a fully-automated waste sorting solution that employs sensor data and “artificial intelligence”. It identifies and reclaims valuable raw materials such as metal, wood, stone, hard plastics, and cardboard from mixed construction and industrial waste. Specially designed for robust performance, the high-speed Cartesian robot identifies objects of different shapes and sizes and is capable of picking up to 2,000 recyclable items per hour. A system with two ZRR robots executes up to 4,000 picks per hour, which is the equivalent of approx. 16,000 tons per annum in a two-shift operation.

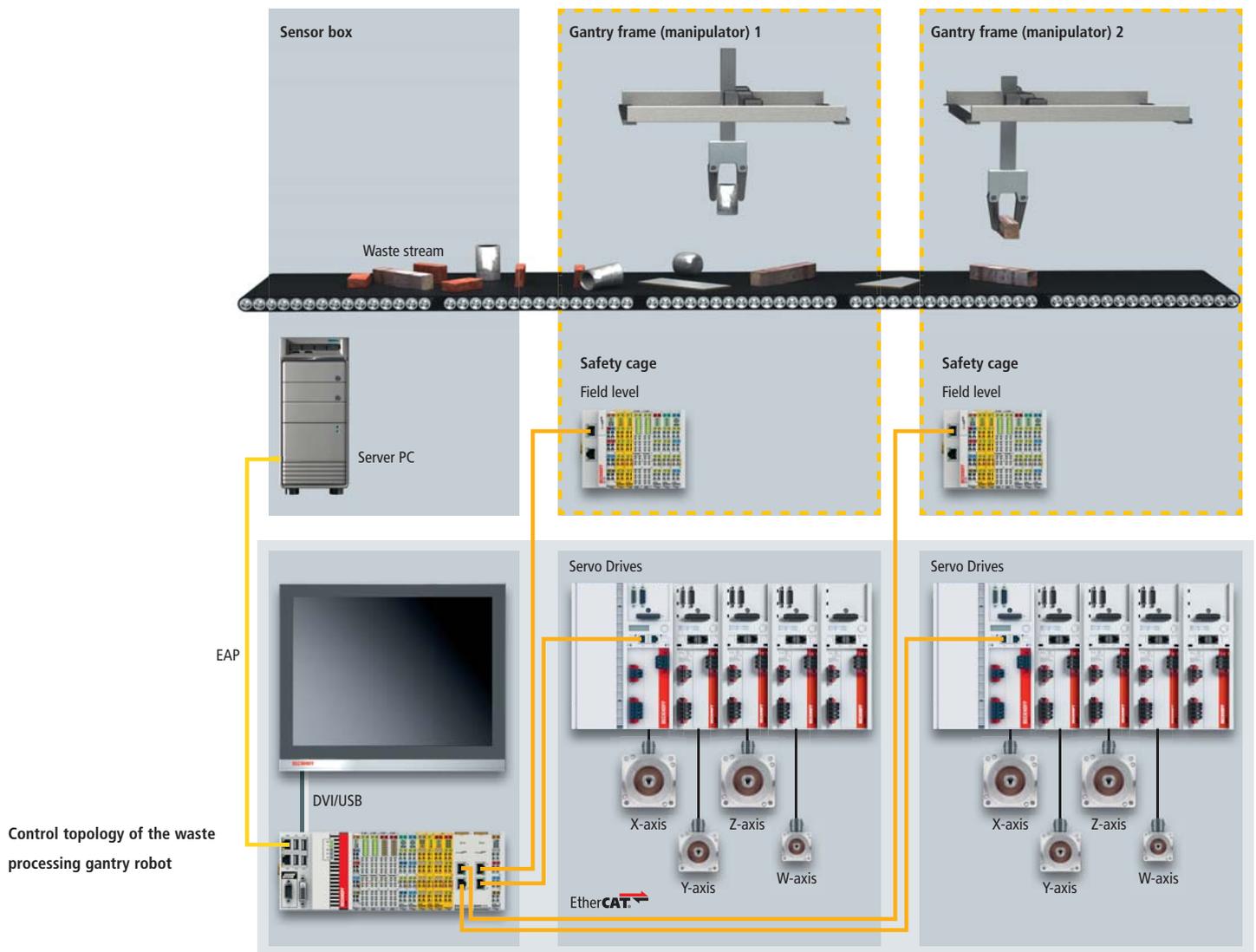
Beckhoff helps make automated sorting processes more dynamic

The master computer processes sensor data in real-time, recognizes the objects on the conveyor belt, and computes the target position for the robot positioning. Motion control is handled by a CX2050 Embedded PC, which also controls all of the system’s I/O operations. The master computer sends the commands for the motion axes, gripper movements, and conveyor belt control, among other functions, via the EtherCAT Automation Protocol (EAP). With acceleration up to 3Gs and speeds of up to 3 meters per second, the robot’s axis movements are highly dynamic. Identifying the various objects coming down the conveyor belt based on their size, shape, and material is only possible with self-learning

robotic intelligence that rapidly responds to continuous changes and learns from mistakes. Because collisions between the robot’s gripper and objects still happen occasionally, the controller must recognize them quickly to prevent mechanical damage and avoid line stops. “TwinCAT gives us a solid handle on the motion control, because we can respond in real-time,” explains Juha Koivisto, the Project Manager at ZenRobotics.

Each robot operates with four AX5000 Servo Drives that include integrated TwinSAFE option cards, and AM8000 servomotors, all from Beckhoff. “By utilizing the motors’ One Cable Technology, we were able to reduce the wiring requirements by 50 percent,” adds Juha Koivisto. The web-based HMI runs on a Beckhoff CP2915 Control Panel with a 15-inch multi-touch screen. “Our customers love the elegant panel design and the modern operator interface technology,” adds the Project Manager.

He is also very satisfied with the control platform’s modularity and component diversity: “Beckhoff offers a wide portfolio of modular and scalable components, which allowed us to be very flexible in designing the system. The ability to manage PLC and motion control within one programming environment has also become a huge benefit. Another plus was the ease of integrating the Beckhoff PLC with other Ethernet-based technologies over EAP.”



Scalable safety solution addresses customer needs

Since TwinSAFE is an integrated part of the TwinCAT platform that can be easily combined with other system components, individual safety objects can be integrated into the project, or excluded from it. "This function is very useful, for example, if you want to include a non-defined number of individual robots into the project," explains Juha Koivisto.

The designer can select from various safety features such as SLS (Safe Limited Speed) or SLP (Safe Limited Position) – depending on customer requirements. "Because of the scalability of the TwinSAFE solution, we can offer our customers safety solutions that perfectly match their needs. The integrated TwinSAFE cards in the drives have the advantage that no additional wiring or drive firmware is required. Any functionalities and enhancements are software-based and can be easily updated."

Efficient recycling based on accurate analytical data

The ZenRobotics Recycler uses several sensor inputs to identify a wide range of objects and/or materials in the waste stream. Consolidating the sensor data makes it possible to more accurately analyze the waste. For the first time, the system can now prepare real-time statistics of the composition, as well as tracking the weights and values of the waste stream. Unlike other sorting methods,

the robotic waste sorting system is able to process specific components with a high degree of accuracy. It can even process multiple components simultaneously, which improves the efficiency of the waste processing system. "Our customers continuously receive software updates, because the ZenRobotics Recycler constantly learns. The software can be updated for better performance or to sort new materials, which makes this a future-proof investment for more profitable recycling," stresses Juha Koivisto.

Automation for sustainable success

"The consistent engineering tool, the modular and highly scalable product portfolio of Beckhoff, as well as the scope and quality of their technical support in the development phase, were important factors for the success of our automation solution," adds Juha Koivisto. "We are already looking forward to the transition to TwinCAT 3 software, which will enable us to shift parts of the higher-level C++ code to the machine controller and further improve the systems' real-time functionality. We also see great benefits for us in the version management capabilities of TwinCAT 3."

Further information:

www.zenrobotics.com

www.beckhoff.fi