Success story

Integrated robotic solution for greenhouses speeds pepper bagging

Bartel Machine is a 38-year-old company based in Leamington, Ontario that designs and builds special-purpose automation equipment using the most advanced technologies from the automation industry's major players. Leamington has one of the largest concentrations of greenhouse growing companies in Canada, so greenhouse machinery is one of Bartel's primary specialties. Although the city has a large population of seasonal workers, there are often not enough workers to cover the needs of the greenhouse industry.

To overcome this challenge, engineers at Bartel pitched the idea of creating a machine that automatically places greenhouse peppers in bags. Because peppers come in a variety of shapes and can be prone to damage if not grasped along their unique contours, the bagging process is largely performed manually. However, if this task were to be successfully automated, greenhouse companies could save time, cut costs, and boost productivity.

> "Automating the bagging process saves greenhouse companies time, cuts costs, and boosts productivity."

Initially, Bartel created two machine prototypes using technologies from multiple automation solution providers. This made it difficult to achieve the degree of flexibility the engineers were aiming for, since any modification would require extra effort to make the different brands' technologies sync. Additionally, inconsistencies in their integration kept the overall efficiency from reaching its maximum possible level. For this reason, Bartel decided to seek out an automation partner that could provide a complete, end-to-end solution.

For the third version of the machine, which is now in production, Bartel worked with automation solution provider Omron Automation Americas. Since Omron products integrate well, Bartel could devote more energy to designing and manufacturing a modular machine that would scale up dramatically in response to changing application needs. To justify the cost of automation, the pepper bagging machine also needed to work well for long periods of time without interruption, which Omron's robotic technologies are also capable of doing.

For Bartel, perhaps the most important benefit of implementing the Omron solution is the ability to change the motion profiles of various actuators with the utmost efficiency. Bartel was able to shave fractions of a second off each machine movement without destroying peppers or bags. These seemingly insignificant improvements are what make the system come alive, and they add up to a tremendous competitive advantage. Bartel likens this strategy to racecar design, in which minuscule changes to aerodynamics at each point on the vehicle can work wonders for its speed over the course of a lap or an entire race.

Did You Know?

A complete solution using technologies from the same automation provider dramatically increases efficiency by shaving fractions of a second off the system's every movement. Although these individual changes may seem insignificant, they add up to a solid competitive advantage over systems using technologies from multiple brands.

Input | Logic | Robotics | Safety & Motion

Sysmac Studio, NX102 Machine Automation Controller

NA5 Human Machine Interface

Viper 6 Axis Articulated Robot

F3SG-R Safety Light Curtains, 1S Servo and E-Stops

The Solution

Peppers, like any vegetable, are quite fragile and should not be tossed around in any automated application. Compounding this challenge is the fact that each pepper possesses a different size and shape that necessitates a slightly different grip. If the system fails to grasp a pepper according to its unique shape, it could bruise or puncture the skin, rendering it unsellable. Finally, the types of bags used today tend to be very thin for cost reduction and sustainability purposes, making it essential for the system to delicately position peppers within the plastic film.

To ensure accuracy in picking peppers, Bartel developed a state-of-the-art gripper and mounted it on the end of an Omron articulated robotic arm. The gripper consists of a 3D-printed body with internal air passages and individually activated fingers that maintain a soft touch. Since each finger works independently, the gripper's hands can self-center on each individual pepper. One gripper uses six hands with four fingers each to pick six peppers at a time. On the robot, six grippers work simultaneously.

A uniquely scalable system

The machine's conveyor contains plates that hold six peppers each. The robot uses the gripper, as described above, to grab the peppers. The machine has a parallel bagging system that individualizes the bags, opens them, and seals them once the robot has placed the peppers inside. The bagging system is composed of linear actuators that use Omron 1S Series servo motors. Multiple Omron sensors are used for part presence and to let the robot know that the plates have arrived.

Together, one robot with two bagging systems, one on each side, represent a single module. Scaling up the entire machine simply means adding more modules, each of which repurposes six or so workers who would otherwise be responsible solely for manual picking and bagging. With fewer workers touching peppers before they go in the bag, the entire process is much more hygienic.

Seamless handshaking via a single platform

One thing that is particularly special about this project is the high level of coordination between the Omron robot and servos. The servos stand out in a variety of ways, including size, controllability, ease of use, and ease of programming in tandem with robotics. The latter benefit is largely thanks to the fact that The Omron NX102 machine automation controller with Sysmac Studio makes it possible to put everything together with a single platform, in one programming language, and on one screen. Making everything "shake hands" properly is easy with an Omron solution.

Bartel appreciated the graphical interface of the Omron NA5 Series human-machine interface (HMI), which is easy to customize. Since the engineers were able to connect the HMI to the robot, the sensors, and the servo drives in Sysmac Studio, the new machine works well across all platforms. This is a significant advantage for a company that designs and builds a wide variety of automated machines. With the NX102 machine automation controller and Sysmac Studio covering the entire solution, there is only one phone call to make if help is required.

Did You Know?

The motivation for this project, and ones like it, lie primarily in food safety and consistency. Greenhouse complexes are large and workers are needed to accomplish complex tasks such as programming the machines and recipe profiles. But by automating repetitive processes like food processing and package handling, food safety can be eliminated as an issue.

Safety with minimal interruption to production

The Omron NX102 and Sysmac Studio IDE and Viper 850 Robot are part of the integrated solution.

Given that peppers are non-linear, there will be events in which bags behave in unexpected ways and operators will need to enter the cell. In these rare but inevitable cases, the bagging line will need to be shut down. Bartel uses Omron safety technologies, including F3SG-RE light curtains for the robot zone and multiple gate interlocks and emergency stop pushbuttons to make sure that the line's motion will automatically stop if a person needs to access the bagging area.

This is also the reason why each module contains a single robot with two separate bagging lines. If one bagging line has an issue, the robot can continue to place peppers onto the second bagging line while an operator safely troubleshoots the first. This innovation helps ensure that production can continue even when challenging problems arise.

The next standard in greenhouse automation

By creating a single-package solution for a task that has previously eluded such a high degree of automation, Bartel and Omron are at the forefront of what is likely to be a groundbreaking development for the greenhouse industry. In addition to freeing up workers to work on more creative and fulfilling tasks, such as programming automation, it also improves the hygiene of sorted vegetables by reducing the amount of contact. Complete with safety and seamless motion within a single platform, the new pepper bagging system sets the stage for more exciting machines to come.