Unique high-speed seed counting and packing solution by Micron Milling

Overcoming the challenge of accuracy for a large retail group

The Micron Seed Packer packs 350 000 seed packs per day with different size, shape and counts of seeds, powered by OMRON's Sysmac technology, 1S Servo and E3NW EtherCAT sensor networking units - a first in South Africa.

The packing of seed in packets with precision and accuracy has always been a challenge. In the eighteenth and nineteenth century, The Shaker Seeds Company in America was the first company to sell vegetable seeds in pre-counted seed packs for household use. Changing the horticultural sector forever. Since then, a lot has changed in the way seed is packaged for distribution to the consumer. Instead of hand counting these seeds and manually placing them in an envelope, seed companies rely on machines to get the job done. One of the many challenges that they face is speed, accuracy and the variable size of the seed.

Micron Milling (Pty) Ltd, known for their high-quality advanced machines reached out to OMRON South Africa to assist on a new project. This project was the first of its kind in South Africa, requiring more investment as well as the latest automation technology and added state of the art control systems to make it work. One of the many reasons the company decided to join forces with OMRON was because of the challenges faced in the past with seed packing machines. Supplying insufficient or over seed packets was a quality problem that was eating into the profitability of the company. The customer wanted to ensure that the end-user was happy with the product they received from Micron Milling and that they received the sufficient amount of seeds. Also, badly cut seed packs can cause a leak and seeds would drop out. Cosmetically the product could look like a poor-quality product - something that the company wanted to avoid at all costs.

"Taking hands with OMRON has been a match made in heaven," said Etienne van Wyk, Design Engineer at Micron

Milling (Pty) Ltd. With OMRON being at the forefront of technology and innovation, this project was off to a great start. "We pride ourselves that we are one of the first companies in Africa to make use of Sysmac Automation Technology, and the advanced 1S Servo System," he highlighted.

The challenge

Any new project or machine has one or two challenging aspects from a design point of view, and this project was no different. This project is completely new and a massive challenge. "We had a previous engineering company specializing in packaging machinery attempt this project, but they failed," noted Etienne. What made this project exceptionally challenging is the fact that it is one of a kind, and it is pushing beyond limits, packing a variable count of seed in a packet. "In laymen terms," Etienne explains, "you need to count the seeds before dropping them into each packet. Each of the 32 variety of seeds differs in size and shape, which adds to the challenge. Seed packs can differ in seed count as well as the packet size, tailored to customer preference."

This machine had to be able to pack almost any width, height, any seed and seed count into little packets, close the packet to be a neat flat envelope, containing the seeds ready for distribution and planting. Counting the seeds before dispensing them in the packs at high speed was one of the major challenges Micron Milling faced. Previous machines in this specific application are not very accurate as some packs had more or even less than the required seeds per pack. This challenge was overcome by the use of OMRON's fiber heads and amplifiers to accurately count the seeds before dispensing them.

To add to the challenge, the Micron Seed Packer needs to pack 350 000 seed packs per day to meet the demand. That is 15 packets per second considering film changes, set up times and changeover. The only way to accomplish this was to make the packets inline before filling them, fill them in a continuous film and to then cut the film at the pre-printed markers. The seed packs had to be precisely cut at the exact mark required to maintain accuracy, even when the machine speed changed. This concept required pre-printed film that varies in colours and also in size. "We overcame this challenge by using OMRON's motion technology, and that enabled Micron Milling to achieve the desired speed and accuracy for the cutting of the seed packs using a rotary knife timed to make a perfect and accurate cut, " Evert Janse van Vuuren, product manager at OMRON explained

"Without the Sysmac Automation platform there was no possibility of doing this project," noted Etienne. The required speed to count the seed into 15 packets per second demands the 1ms communication speed of the Sysmac system. The 1ms response on the super-high-speed EtherCAT communication coupled with the E3NW Ethercat Fiber communications unit, allowed Micron Milling to detect and count seed of fewer than 250 microns at 750 seeds per second, with 16 fiber amplifiers and 32 amplifier heads running simultaneously.

The 1S Servos, in turn, allowed them to have precise position tracking cutting with direct feedback from the accurate IO-Link E35S mark sensor.

Without the unique instantaneous switching from position to torque feedback mode on the 1S Servo, cutting of the film would not have been possible. It's not a challenge to cut the same size packets all day but switching between sizes is where the challenge comes in- different size packets with different size seeds, just to change the packet width, in real-time from packet to packet. "That means tracking the marker in real-time and in turn calculating the cutting position. In fact, on this project the cutting position is being updated every 2ms to allow the machine to cut with a 2mm accuracy," explained Etienne.

The solution: Sysmac to the rescue

To achieve these numbers, the complete system had to be designed from start to end to allow all these separate sections of the machine to keep up. This can be considered the biggest challenge of the project, and Sysmac Automation Technology was the leading factor making this work. With South Africa going into lockdown on the 26th of March 2020, Micron Milling only had 4 weeks to manufacture the machine. The pressure was felt by the team and 2am mornings in the workshop was nothing out of the ordinary. Troubleshooting while under pressure is any automation engineer's worst nightmare. Looking for possible problems while the due date is crawling closer was making matters worse. "This is where the Sysmac System shines the brightest," Etienne answers with a smile when asked if he believes that the Sysmac Automation Platform made the planning and implementing of the Micron Seed Packer easier. "Wiring the 1S Servos, the controllers and the touchscreen, the automatic detection of the complete network and all drives and controllers on a single platform, the 1S simplistic Servo calibration, just made everything super-fast and a breeze and allowed us to concentrate on what matters the most," he said.

Testing and optimizing is still needed, as with any new system or machine, but it happens so much quicker and with less hassle when using Sysmac. The rapid development platform of the NA touchscreen clears the way for an integrator or OEM to match the feel and control to the rest of the machine. The complete electrical and automation system requires less time and can be done without hassles.

The EtherCAT advantage

What gives EtherCAT an advantage over other protocols is that it is much simpler to use. A 1ms response was required for this project, and EtherCAT could make that possible. Fault finding is also much easier and the ability to merge a network layout with the click of a button is the way forward. "As a machine developer and working with design, research and development daily, I have yet to see a more suitable network protocol," states Etienne.

The wide beam fiber sensors were mounted in a special mounting block system where the seeds pass through a 10 x 10mm gap, when the seed is falling through the fiber beam, the fiber amplifier would measure the reduction in light received. Using a simple calculation, the size of the seed can be determined and counted in turn. This further allows for limits to be set up to only count the amount that is required, rather than certain size limits.

When asked if the machine supports Industry 4.0 technology, Etienne answered as follows, "This specific machine supports IoT as well as Industry 4.0 technology, but is not connected to the cloud as it is not a requirement for this specific project."

Rising above the rest

"The high-speed counting of seeds on this scale is something I have never seen done before. The technology that allowed us to count at this speed and the accuracy that we have reached is state-of-the-art and I do not believe this would have been possible 3-4 years back. Although the cutting programming code, and how we update the cutting position is kept under guard, the 1S Servo together with this coding principle is the state-of-the-art technology. We can update cutting position every 2ms even if the sensor misses the mark," states Etienne. This is not possible with normal servo motors. The key criteria on which Micron Milling judged the success of this project was plain and simple - perfection. Zero waste was also a key point in terms of zero wasted product for the end user. "We achieved our goal," Etienne said.

For a better future

The End User of these seed packs is large retail group that are currently using these in a nationwide marketing campaign. The retailer was criticized heavily during the first campaign it ran as the seed packs and sets was imported from overseas. The retailer explained that they did contact various suppliers at that time, and that not one of the seed companies could assist in the supplying of 192 million seed packs. The retailer then contacted Micron Milling for its second campaign after trying machines from various other OEM's and asked if a better solution could be supplied. And of course, Micron Milling raised up to the challenge, they contacted OMRON and the rest is history. The Micron Seed Packer is unique and new to the market. The speed at which it packs, and the design that allow it to pack various sizes, is by far its biggest advantage.

"During the lifetime of this project, 156 temporary positions were created in the eight months the project ran in Johannesburg," said the retailer. After the finalization of the project, 15 of these workers received permanent employment elsewhere with the skills they learned during the course of this project.

The Micron Seed Packer benefits society in a big way in the sense that seed almost always ends up in community hands, in most cases without paying for it directly or indirectly. "Imagine 350 000 packets of tomato seeds that end up in the community's hands and let's assume only 10% of these packs will be planted. If each plant brings up only 1 kilogram of tomatoes in its lifetime, that means that the Micron Seed Packer delivered 35 tonnes of food per day to the community," Etienne concludes.

(Additional information referenced in the last paragraph is from Rapport, 20 April 2020.)

About Micron Milling

Micron Milling is a both a food processing equipment specialist as well as manufacturer of special purpose machines. They can help with the development of OEM machines or develop HMI interface control and motion control systems to fit customer needs. They are especially knowledgeable in the field of replacement of expensive international automation machines that will normally be imported. All machinery comply with the highest standards of health and safety requirements. Training is a standard included with all production facility installations. From Vision systems to do inspection to robotics, Micron Milling can do it all, and they are a proud supplier of OMRON equipment in South Africa. www.micronmilling.com

About Omron

OMRON Corporation is a global leader in the field of automation, based on its core technology of 'Sensing & Control + Think.'OMRON's business fields cover a broad spectrum, ranging from industrial automation and electronic components to social infrastructure systems, healthcare and environmental solutions. Established in 1933, OMRON has about 30,000 employees worldwide, providing products and services in some 120 countries and regions. In the field of industrial automation, OMRON supports manufacturing innovation by providing advanced automation technologies and products, as well as extensive customer support, to help to create a better society. For more information, visit OMRON's website at www.industrial.omron.eu.