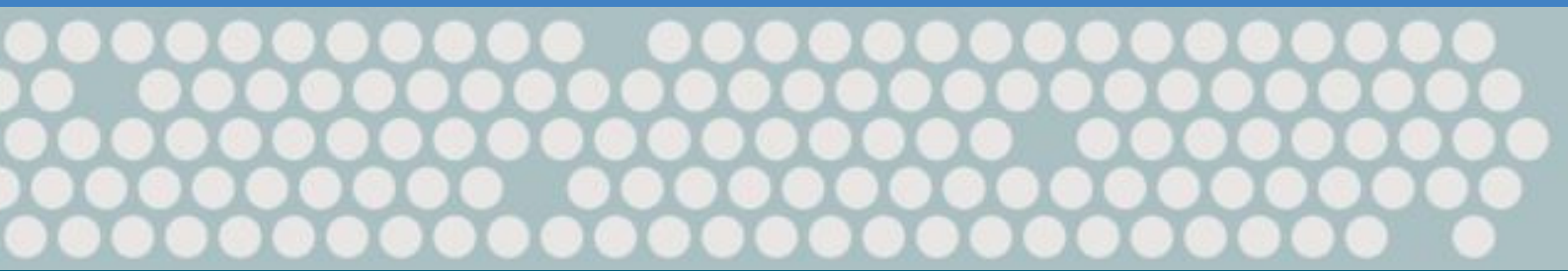




AI and automation

smart robotics

# TAKING FOOD PROCESSING TO THE NEXT LEVEL



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# 'WE BELIEVE THAT FOOD PROCESSING CAN BE FULLY AUTOMATED'

Inserting fruit or vegetables into a machine can be a grueling and monotonous task that you wouldn't want your employees to be stuck with all day. It's a job that can take a toll on their health and motivation. Ideally, you want your workforce to find fulfillment in their work, remain in good health, stay motivated, and not feel compelled to seek better opportunities elsewhere.

However, addressing this challenge sometimes seems hard. Fruit and vegetables come in various sizes, shapes, and colors, making automation difficult. We've taken steps to tackle this issue by incorporating cutting-edge vision and robotic technology. Now it's establishing a dedicated division within our company. Our machines more and more make use of neural networks, making the recognition and orientation of products nearly effortless. The full automation of processing oddly shaped products isn't a distant dream; it's a reality today.

For more details, we invite you to explore the contents of our white paper. Please feel free to reach out to us if you have any questions or require further information.



**HANS KEIJZER**  
CEO



# ARTIFICIAL INTELLIGENCE AND THE INCREASING ROLE IN FOODPROCESSING

Artificial Intelligence is playing an increasing role in the food processing industry, where it is being used to improve various aspects of production. The integration of AI in food processing offers several benefits, including improved product quality, higher efficiency, cost savings and better food safety. It enables manufacturers to work more accurately, optimize processes and deliver high-quality consumer products.

## Applications of AI in food processing

### Quality control

AI can be used to automatically inspect and control the quality of food products. For example, image recognition techniques can be used to identify visually abnormal products, such as damaged or contaminated products. This helps manufacturers ensure high quality products and reduce the need for manual inspection.

### Sort and classify

AI algorithms can be used to automatically sort and classify food products based on various criteria, such as size, color, ripeness, texture, position and so on. This improves the efficiency of the sorting process and ensures that products are distributed uniformly.



## Optimization of production processes

AI can help optimize production processes in food processing. Using advanced algorithms and machine learning techniques, manufacturers can adjust machine and production line settings to increase efficiency, reduce energy costs and improve product quality.

## Predictive Maintenance

AI can monitor the condition of processing equipment and machinery in real time. By analyzing data from sensors and other sources, AI can predict when equipment might malfunction or require maintenance. For example when there's a peel or a stone jammed in the machine This proactive approach reduces the risk of unexpected breakdowns.



Robotization plays an important role in automating and optimizing processing in the food industry. By using robots, various tasks can be performed more efficiently and accurately.

## HOW ROBOTIZATION CAN BE APPLIED IN FRUIT AND VEGETABLE PROCESSING

### **Pick-and-place**

Robots are used to pick up and move products during the processing process. They can be programmed to sort, stack or place items in containers or into a machine, reducing the need for manual labor.

### **Packaging and palletizing**

Robots are often used in packaging lines to pack products into boxes, bags or trays. They can also be used to stack and organize these packaged products on pallets. This improves the speed and precision of the packaging process.

### **Cutting and shredding**

Robots are used for automatic cutting and shredding of food products, such as vegetables and meat. They can be programmed to cut products into specific shapes and sizes, improving the consistency and quality of the final product.

### **Replacing difficult manual labour**

Utilizing robots introduces a clear distinction between humans and knives. For example a robot can execute precise, centered drilling. No manual inserting required so this eliminates the need for hard-to-clean protective elements.



## WHAT IS DEEP LEARNING EXACTLY?

While the original goal for AI was broadly to make machines able to do things that would otherwise require human intelligence, the idea has been refined in the decades since. Francois Chollet, AI researcher at Google and creator of the machine-learning software library Keras, says, "Intelligence is not skill itself, it's not what you can do, it's how well and how efficiently you can learn new things."

Deep learning is focused on improving that process of having machines learn new things. With rule-based Artificial Intelligence and Machine Learning, a data scientist determines the rules and data set features to include in models, which drives how those models operate. With deep learning, the data scientist feeds raw data into an algorithm. The system then analyzes that data, without specific rules or features preprogrammed into it. Once the system makes its predictions, they are checked against a separate set of data for accuracy. The level of accuracy of these predictions—or lack thereof—then informs the next set of

predictions the system makes.

The "deep" in deep learning refers to the many layers the neural network accumulates over time, with performance improving as the network gets deeper. Each level of the network processes its input data in a specific way, which then informs the next layer. So the output from one layer becomes the input for the next. Training deep learning networks is time consuming and requires large amounts of data to be ingested and tested against as the system gradually refines its model. Neural nets have been around since the 1950s, but only in recent years have both computational power and data storage capabilities advanced to the point where deep learning algorithms can be used to create exciting new technologies. For example, deep learning neural networks that have made it possible for computers to carry out tasks like speech recognition, computer vision, bioinformatics, and medical image analysis.

source: HP Enterprise

# SEED ORIENTATION AND PICK AND PLACE



What is it? Dirt, a little fly or a broken seed?

The act of planting seeds is a meticulous and time-consuming task, but it's also a process that can be automated.

Moreover, you can implement deep learning techniques to train a machine to detect and select only the intact seeds. This means that dirt, sand, small flies, or any other strange objects mixed in with the seeds should be excluded. Once the machine has acquired the ability to distinguish between seeds and non-seed materials, a specialized nozzle can be employed to vacuum and precisely place each seed in the desired location, such as small containers.



# 'ORGANIC PRODUCTS ARE NEVER THE SAME'

THAT MAKES THE CHALLENGE BIGGER,  
BUT NOTHING IS IMPOSSIBLE

Nature's beauty lies in its diversity—no tree or plant is identical, and the same goes for their offspring, such as fruits. Take the bell pepper, for example. Some are red, some are green, and others display a combination of both colors. The shapes vary too, ranging from small to large, and there are even some amusingly unique-looking peppers. Some have stems, while others do not.

As humans, we possess the remarkable ability to recognize and differentiate these peppers. But how do we accomplish this? What enables us to determine the orientation of a bell pepper? Our brains are adept at tasks like orientation and classification, which is why, until now, most machines have relied on human input. However, in a world where skilled personnel is becoming scarce and demands are rising, finding people for this job is increasingly challenging.



In the past, developing a robust algorithm for quickly and accurately determining the orientation and quality of natural products proved to be time-consuming and difficult. This is primarily due to the inherent variations in shapes and colors among natural products, which further differ across seasons. Consequently, it has been challenging to identify consistent features for algorithmic analysis, resulting in the programming of reliable and robust algorithms being a daunting task.

Nevertheless, with the advancements in computing power—faster and more affordable than ever—it has become feasible to simulate the capabilities of the human brain and learn algorithms. Recognizing the potential of these neural networks, ZTI has focused on integrating them into our machines.

We have developed generic software that enables rapid algorithm development and testing. As a vision and robotics engineer at ZTI, I discovered that with a relatively simple setup comprising a buffer, conveyor belt, camera, laptop, and robot, we can effectively orient and position a wide range of fruits and vegetables in our processing machines. The possibilities, in theory, are endless. So far, we have successfully oriented physalis, oranges, bell peppers, strawberries, radishes, and mango cheeks. Additionally, we have experience in testing seeds for quality determination.

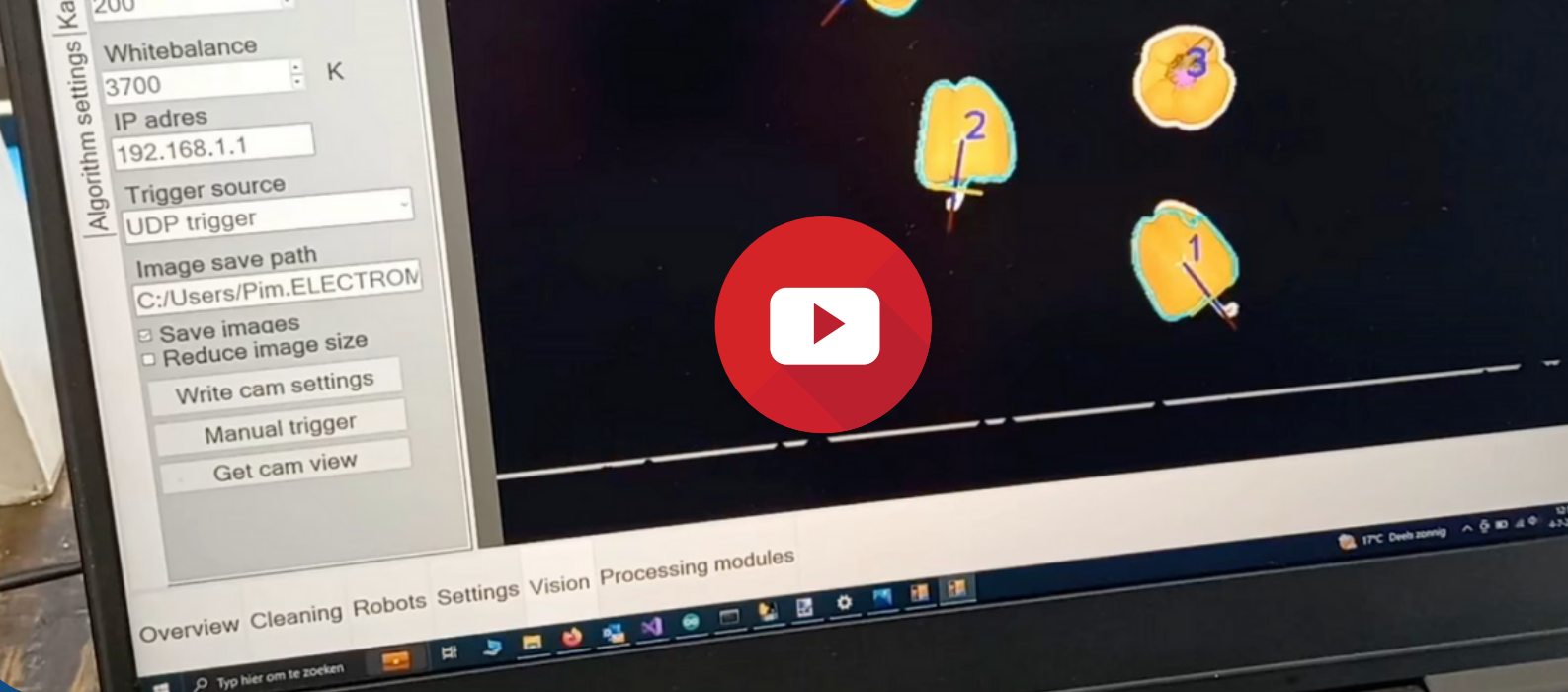
By developing the software in-house, we seamlessly integrate it with our machines and robots. During the vision process, extra information can be generated, particularly when employing 3D cameras. This additional data supplements the peeling and processing of products, enabling us to achieve optimal yields. For instance, a customized recipe can be generated for each fruit piece, accounting for size differences. Moreover, we can

choose to process only the uniquely-shaped products and package the visually appealing ones for direct sale to consumers. Using our own software also offers the advantage of running all operations locally, eliminating the need for an internet connection or subscription.

Robotization not only reduces standstill time but also enhances machine safety and operator convenience. While prioritizing operator safety and ease of use increases complexity (e.g., incorporating light screens and shielding sharp parts) in our machines, by employing robots for loading, we circumvent these risks and simplify the machine design. This reduction in complexity translates to cost savings through part reduction. Furthermore, operational costs are minimized, as machines with fewer parts are easier to clean. Thus, robotization offers an even more favorable return on investment (ROI).

Vision and Robotics Engineer @ZTI  
Pim Bakker





## FULLY AUTOMATED BELL PEPPER LINE

The manual process of cleaning and parting bell pepper is now a thing of the past. With the increasing demand of pre-cut bell pepper in convenience food bags in stores, the demand for cleaned and cut bell peppers has . This led to an increase in people performing labor-intensive and repetitive tasks. Consequently, there was a need to automate this process.

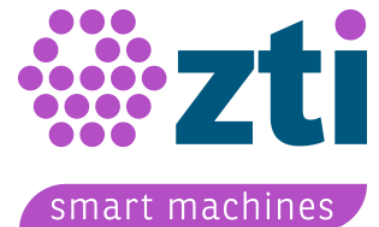
Even the manual placing of bell peppers in a machine is now considered outdated. Thanks to AI and vision technology, the entire process can run autonomously.



A camera scans the paprika on the conveyor belt, providing precise information to the robot arm's control software, ensuring accurate handling. A silicone gripper picks up the paprika and positions it in the machine. Notably, the machine is much simpler and easier to clean since the need for additional safety curtains and barriers has been eliminated.

Once the paprika is inside the machine, it is cored and segmented. From the input bunker to the output conveyor belt carrying paprika segments, no human intervention is required in the process.

# OUR MACHINE SOLUTIONS FOR MORE YIELD, GOOD ROI AND LONGER SHELF LIFE



Fruitcutter  
e-line



Mango Peeler-de-  
Cheeker 20



Fruitcutter Bell  
Pepper



Cabbage Corer  
and Wedger



Pineapple Peeler



Cabbage sorting  
line



Watermelon  
Wedger



Fruit and  
Vegetable Wedger

- Thin peeling knives that follow the contours of the fruit
- Easily adjustable peeling thickness
- Fitting trays for equal cubes
- Shaped knives for destoning
- Variable cutting cylinders
- Moving sharp knives for longer shelf life



Check our [website](#)  
for an overview of all  
our machines!



smart robotics



smart machines

Thank you for reading this whitepaper. I hope it was a good and useful read for you. If you have any questions, or need an overview of all our machines, please contact us by the link below.

