The bacon that you enjoy at breakfast should have the right amount of fat – not too much, not too little.

The Danish Meat Institute researched this issue and collaboratively developed a precision meat cutting machine.

The core of the machine is an especially compact, real-time capable control/drive solution.

Cameras and sensors continuously measure the fat layer
With Attec Food Technology – a Danish specialist for meat processing machines – the Danish Meat Research Institute found a partner with whom they were able to develop a completely new solution. The intelligent meat trimmer is the result of this collaboration. This employs state-of-the-art photo-optical analysis in conjunction with an intelligent control system. This allows the pork loin to be precisely cut so that no more than the maximum specified layer of fat exists at any position along the strip of bacon. To achieve this, the pork loin fed into the machine is first precisely analyzed. Two cameras photograph the meat profile from the side and from above. An additional ultrasonic measurement also determines the precise percentage of fat.

Tican’s slaughterhouse is located in the Danish town of Thisted. It is a cooperative and belongs to approximately 350 Danish pig breeders and exports meat to all corners of the globe.

Every country has its own quality specifications, and these can also differ from product to product. Some people like their meat absolutely lean and only accept a maximum fat layer of 5 mm, and others accept up to 35 mm. Those responsible in Tican selected a mechanical solution to remove excess fat from the pork loins. Up until now, this was done by feeding strips of meat through a machine using two rolls. A simple horizontal knife was then applied to remove a certain thickness of fat. The only problem that was encountered is the fact that pork loins are marbled differently, so the fat is never evenly distributed.

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The core of the machine is an especially compact, real-time capable control/drive solution.
The data acquired is evaluated to obtain a three-dimensional digital profile of the piece of meat. The thickness of the fat layer is determined in both the longitudinal as well as transverse axes.

**Touch panel operation**

A stainless steel Siemens SIMATIC multipanel with touch display is used as HMI device. The stainless steel housing means that it can be cleaned in compliance with food industry specifications. The operator panel displays the two camera images of the piece of meat being currently processed – and in addition, the ultrasonic measurement with an average cutting curve calculated by the system. The required cutting parameters are taken from a product and customer-specific recipe database. These parameters can also be manually entered. There is also a cleaning mode where the machine is moved to a specific position to provide the maximum degree of accessibility for the high-pressure cleaning system.

**Cutting with eightfold precision**

Contrary to conventional meat trimmers with only one knife, with the new machine, the horizontal cutting surface is subdivided into eight segments. Each segment is equipped with a separate knife blade, which can be specifically controlled and positioned. Based on the image data and the ultrasonic measurement, the control electronics of the machine calculates a digital cutting profile for each individual piece of meat.

**Fast data acquisition, fast response**

The problem was that there are only a few milliseconds between acquiring the image and cutting into the meat. In this short time, the data from the camera and ultrasonic sensor must be transferred and read into the control program.

The precise cutting characteristic of eight blades must also be calculated and finally the setpoint positions made available to the actuators of the eight knives fast enough to control them in real-time. Smart software development and fast data transfer were an absolute must in order to comply with these requirements.

**Compact systems are required where space is restricted**

The experts selected the SIMOTION motion control system for the complete machine control and for converting the cutting characteristic into actual knife motion. As a simple and flexible motion control solution it was specifically developed, to be optimally suited for use in machines such as this intelligent meat cutting machine. PROFIBUS is used to establish the connection to the image processing IPC, thus guaranteeing real-time communication. The SIMOTION D version is used in the new meat trimmer in which the motion control is merged with the PLC, technology functions and an integrated SINAMICS S120 drive. This solution where the intelligence is integrated in the drive means that all time-critical signals are completely transferred without involving any interfaces, therefore guaranteeing the necessary response time. With SIMOTION D for the motion control and SINAMICS S120 as drive system, an extremely compact design is achieved so that a separate control cabinet is not required. This is because the complete assembly comprising motion control and drives is directly integrated in the machine itself. Further, the motion control system sets itself apart as a result of its especially efficient operation, which significantly reduces the energy costs for this meat trimming system. Max Pedersen from Danish Meat Research Institute also shares this opinion, and adds: “It is fascinating to see just how smoothly image processing, process control, motion control and drives operate together in order to precisely obtain the layer of fat that the customer has specified.”

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### Highlights

- Real-time communication via PROFIBUS
- High response speed as critical signals are transferred without involving interfaces
- Space-saving through a compact design without control cabinet
- Simple and flexible motion control
- Efficient system operation