AMPC

SNAPSHOT

Integrated Robotic Picking and Packing of Primal Cuts

Project Report Reference: 2017-1065 **Date: 5 October 2017**

Project Description

The development of a completely integrated robotic pick and pack system capable of efficiently picking and packing vacuum sealed primal cuts into cartons. The system consists of a six-axis industrial robot, a vacuum pad foam gripper, and a high-resolution three-dimensional computer vision system. Identification of the primal cut to be packed and determination of the pick and pack parameters for accurate pickup and placement into the carton was required. A total of ten (10) different types of primal cuts were selected for in-house system trials.

Project Content

Meat processing plants suffer significant labour costs and workplace health and safety risks associated with the manual picking and packing of primal cuts after processing. As such, the successful development and testing of a completely integrated vision and robotic pick and pack system would mitigate the risks associated with the implementation of such a system in commercial red meat processing plants.

The terms of references were to:

1. Determine a subset of primal cuts that can be robotically packed with commercially available off the shelf robotic grippers and previously developed vision sensing software from the AMPC 2014-1007 project.
2. Develop a robotic picking and packing system that efficiently packs vacuum sealed primal cuts into cartons.
3. Trial system in-house and report on its efficacy and suitability for later implementation in a plant environment.

The project focuses on the selection of an appropriate robotic gripper, the hardware componentry for complete integration between the robotic, transportation, and vision systems, and the developed vision and pick and pack algorithms.

Project Outcome

Packing was successfully performed on all ten (10) different primal cuts to rigorously test the system's limitations. The subset of cuts uses in the project are as listed below:

- Topside
- Chuck Roll
- Clod
- Bolar Blade
- Point End
- Striploin
- Rump
- Knuckle
- Tenderloin
- Short Ribs

The vision system was able to determine an optimal pack position, and hence an ideal pick position for the gripper, given the existing packing configuration of the carton as seen in Figure 1. Primal cuts were able to be picked at any orientation with respect to the conveyor as shown in Figure 2, and packed accurately and efficiently into their cartons, regardless of the gripper angle required for packing. The selected gripper was able to transport the primal cuts at high speeds while maintaining vacuum bag integrity and handle the wide range of primal cut sizes, shapes, masses, and surface contouring without modification. An average round trip cycle time of 7.157 seconds was calculated for all the primal cuts which could be further reduced through speed optimisation if required. Figure 3 show an overview of the complete system trailed in-house. Figure 4 and Figure 5 highlight the versatility of the system to handle both flat and sideways packed primal cuts.

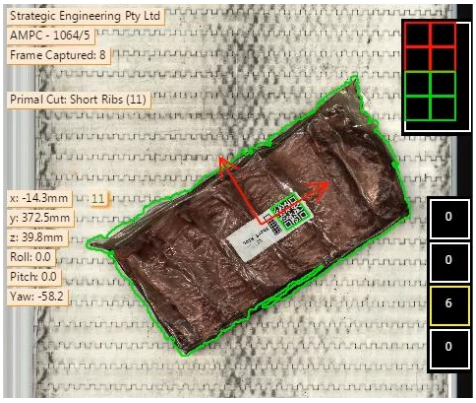

Figure 1: Vision System output detailing pick coordinates and yaw rotation (left), gripper modules to activate (top right), and destination carton and current number of primal cuts in carton (bottom right).

Figure 2: Robotic arm viewpoint of in-house trials highlighting pick coordinates and yaw rotation.

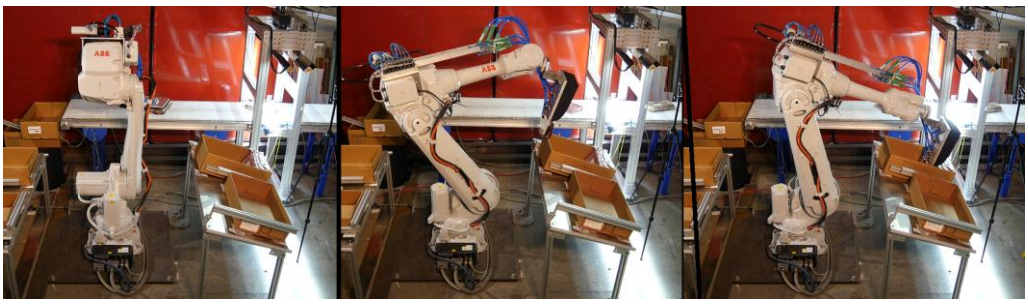

Figure 3: Integrated robotic and vision system operating during in-house trials.

Figure 4: Flat packing process (left to right) for Clod

Figure 5: Sideways packing process (left to right) for Striploin

Benefit for Industry

Through this project an automated robotic cell capable of efficiently picking and packing primal cuts without the need for manual intervention was developed and demonstrated to perform effectively. If implemented in a commercial meat processing plant, the system could feasibly replace a number of labour units with a single robotic cell. No changes to existing packing conventions would be required due to the system's ability to emulate existing commercial packing configurations. Additionally, multiple robots may be used to accommodate a wider range of primal cuts and increase pick and pack speeds if desired.