final report

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Prepared by: Aaron Dowling and Stuart Shaw

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Robotic Forequarter Vac San Project Implementation Report

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Introduction

This document covers the implementation of a Robotic Vac San System for the sterilisation of the forequarter area of a sheep/lamb. The robot system was installed at Country Fresh/Peel Valley Exporters plant located in Tamworth NSW by Machinery Automation and Robotics. The robot was installed in May 2008 and went into full production on 8th August 2008.

The system replaces the manual operation of using a handheld vac san wand and delivers a consistent vac san path on each carcass passing through the system. The system is located right before the hide puller on the production line. It consists of safety guarding, safety equipment, operator controls, sensors and a Kentmaster vac san wand fitted to a standard ABB IRB140 Robot.

This is a turn key solution which is started and stopped at the operator panel. Upon start-up the robot autonomously tracks and vac sans every carcass that passes through the cell.

Peel Valley will conduct further swab testing to ensure before and after bacteria counts are acceptable.

The first system that has been installed meets the solution requirements of the project with room for improvements.

About the system

The system aims at replicating the actions of a manual operator. Manual operators were studied and it was noted that they look for impurities to vac san, others do a consistent path and some of the carcasses are not covered at all. The objective of this system is to consistently vac san an area with a fixed path that will vary with the length and thickness of the fore legs.

The vac san path consists of 6 strokes (3 stokes down each leg) where each stoke starts at the top and moves down as shown below in Figure 1. The strokes have been arranged to maximise effective use of cycle time. The sheep is presented with its fore legs hooked into a fixed spreader. The path is more effective if the sheep entering the cell are stable and in the correct orientation which is with the brisket facing the robot.

Where to next

MAR will be seeking interested processing companies to further develop the front vac san system with a second Robotic Forequarter Vac San system within the coming months as part of the initial development project with a further two systems being installed late 2009/10 completing the development prior to commercialisation.

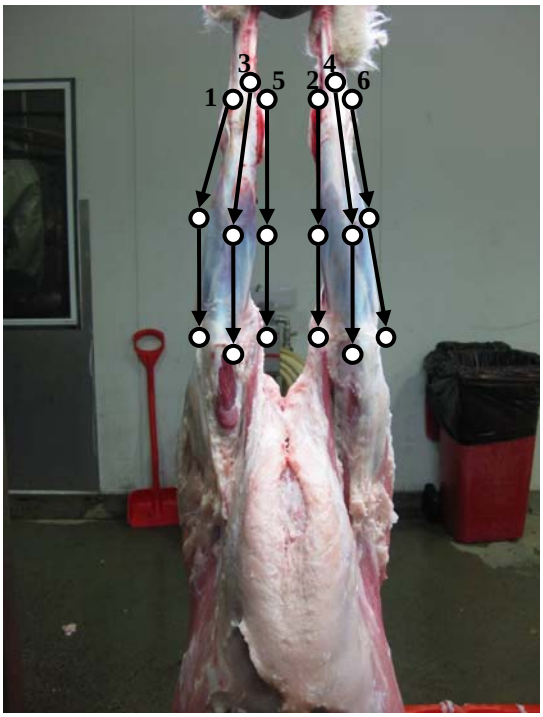

Figure 1 Robotic vac san path

Figure 2 Fixed Spreader

System Design

The robot cell is located in the same position as the original manual process which is right before the hide puller. Figure 3 below shows both the forequarter vac san and brisket saw is installed in the same robot cell saving potential floor space. Note the safety guarding, safety mats, robot position, operator panels, access gate and the main line which passes through the cell.

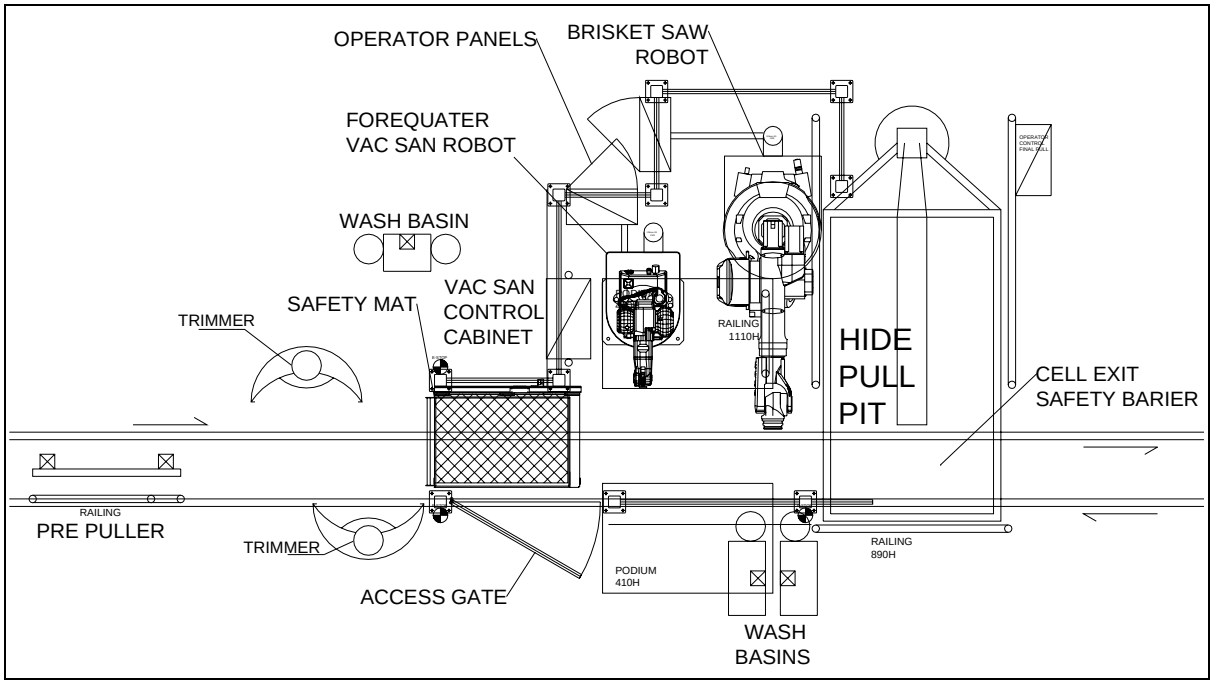

Figure 3 Robotic Vac San layout

Safety Guarding

The safety guarding is made with stainless steel posts and 6mm clear scratch resistant polycarbonate sheets. The safety guarding is designed to prevent personnel from coming in contact with the robot.

Figure 4 Robot cell with protective guarding

Safety Mats

The safety mats have been installed to protect personnel around the robot cell from coming in contact with the robot. The safety mat triggers when a person or a weight is on them. The floors may be lifted up and held back with a chain and hook for cleaning purposes.

Figure 5 Safety Mat

Robot & Vac San Wand

The robot is an ABB IRB140 with a Kentmaster vac san nozzle mounted to it with a white protective cover.

The vac san wand has been fitted with an air cylinder. The cylinder is designed to apply an even amount of pressure as the vac san nozzle passes over bumps and variations on the sheep during the vac san.

The protective cover is made from PVC taught-liner material and is custom designed to fit the robot and protect the robot from water entering into the motors. The bag is inflated to allow free movement of the robot within the bag and create Positive pressure to also stop ingress of water into bag.

Figure 6 Vac San Gripper

Operator Panel

The robot system is started, stopped and reset from the operator panel. There is also a digital temperature gauge on the panel showing the temperature of the hot water at the vac san nozzle. The operator panel may be used to stop the robot immediately using the emergency stop. The fortress key shown on the panel allows maintenance staff to isolate the system and attend to robot issue via the inspection gate located on one side of the robot cell.

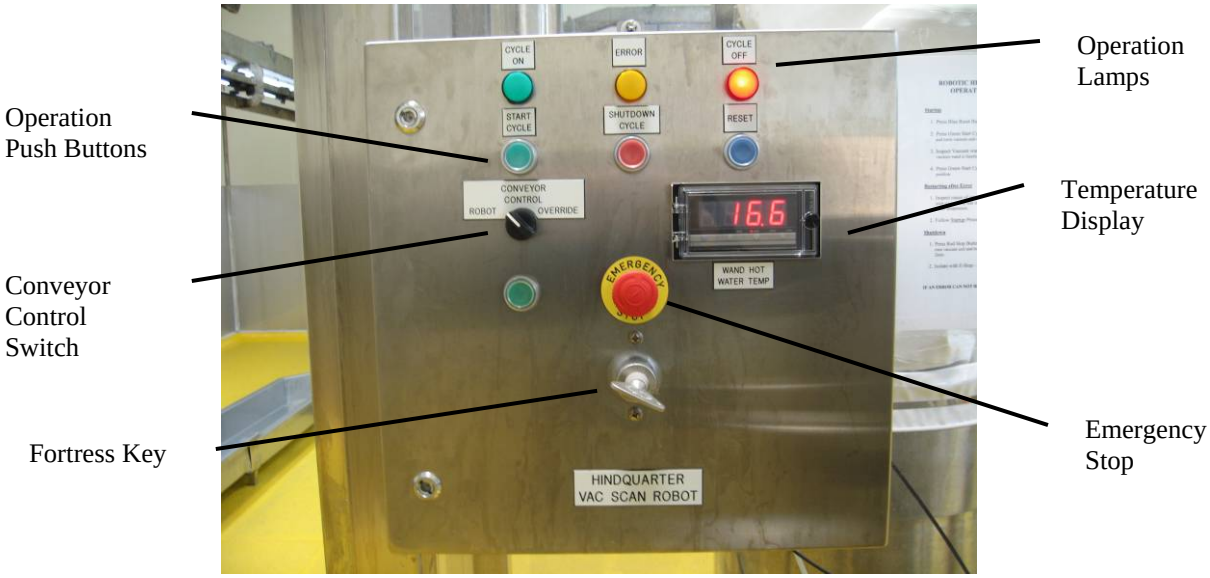

Figure 7 Operator panel

Sensors

The main sensors include the following:

1. Brisket distance laser
2. Leg position sensor
3. Hot water temperature sensor

Brisket distance laser

This laser is located above the chain conveyor. When the carcass passes into the robot cell, the laser records the height of the brisket area between the legs. The robot program then selects the maximum distance reading which is the highest point on the brisket. The program uses the distance to position the vac san nozzle accordingly.

Leg position sensor

This sensor locates the leading and trailing leg on the carcass and also begins tracking process. The program uses the leg positions to adjust the vac san path to maximise the effective contact with the fore legs.

Hot water temperature Sensor

There is a temperature sensor located on the vac san wand. The temperature is displayed on the digital display on the operator panel. Once the temperature reaches the minimum operating temperature of 82.5°C an output from the display allows the robot system to run. If the temperature falls below 82.5°C the error lamp will be lit and a warning message will be displayed on the teach pendant and allow the system to continue. If the temperature falls below 70°C during autonomous operation the system will automatically shut the cycle down.

Vac San System

The original manual vac san is a Kentmaster system. The Robot System basically switches the vac san on and off like an operator. The vac san system is self contained and operates independently from the robot system. The vac san has gauges to measure vacuum, hot water and steam pressure and temperature.

Functional Operation

The system is started at the operator panel by the press of the start push button. Upon cold start the system performs a warm-up routine which allows the steam and hot water to reach temperature. Once the system has reached temperature, the operator presses the start button again to resume cycle. The robot moves to a waiting-position ready for a carcass.

A vac san cycle is started when the positions of the fore legs are recoded and they pass a threshold test. Simultaneously, the brisket height is recorded and also threshold tested. The tests prove a sheep has been identified and the cycle begins.

Upon each cycle the robot performs 6 fixed stokes on the forequarter and then returns to the waiting-position ready for the next carcass.

In the unexpected event the gripper on the robot collides with the carcass the robot stops and resets itself by returning to the wait for carcass position. The program will not self-reset if the error has occurred 3 times within 2 minutes.

The system is shutdown by pressing the shutdown push button. The robot will go to the shutdown position and run a purge routine for 2mins to remove fat from the vacuum lines before shutting down. The shutdown position has been selected to remove the gripper and robot away from the carcass and provide a position for cleaning.

AQIS inspection and Swab Testing

Before and after swab testing was carried out by the Peel Valley Quality Assurance Team.

We are waiting on swab testing results from the Quality Assurance Officers at Peel Valley.

Customer Feedback

John McClusky the Plant manager at Peel Valley Exporters, is keen to see a continuation of further robotic developments and innovation at Peel Valley in the near future based upon the success of this system.

Project Outcomes

Carcass Variation

The major challenge of this project is the ability to adapt to the variations in carcass shape and obtain a sufficient level of coverage. The variation in shape was mostly over come by implementing compliance in the vac san nozzle by applying a small amount of pressure with a single air cylinder. This compliance removes sophisticated measurement techniques such as vision, 3D laser scanning and thermal imaging simplifying the measurement down to a total of 2 single point lasers. This method has considerably improved the durability and simplified fault tracing for the maintenance crew.

Carcass Tracking

An ABB robotic conveyor tracking module was used on the system and has proven to meet the requirements by being able to track carcasses at various speeds and even stoppages with an acceptable level of accuracy.

Product Integrity

The system performs the same path over each carcass and varies the height and leg positions depending on the sensor readings. This provides a consistent coverage of every carcass.

System Design

The hinged safety floor offers a practical method of securing the robot cell and convenient access to cleaning.

Clear polycarbonate offer a clear view of the robot in operation. Although the system is autonomous, it’s still necessary to check the robot periodically in the case meat is jammed in the nozzle or it’s malfunctioning in some way. Installing clear polycarbonate sheets is a good initiative.

The operator panel provides the simplest task of starting, resetting and stopping the machine. The panel is robust and suitable for the food industry.

Operation

The system is simple to start, reset and stop. During autonomous operation the robot will vac san every carcass provided they are within threshold.

Rates of Operation

The system is currently operating at a line speed of 8-9 carcasses/min and capable of higher line speeds for future developments.

Future Improvements

- The vac san wand currently moved in one direction which is down. This allows the cycle enough time to perform a vac san of 5 strokes before the cycle time is up and moves to the next sheep. Coverage of the sheep may increase if the vac san wand is further developed to increase flexibility and allow bi-directional paths.

- The white bag protecting the robot from wash down is a must for a robot system however the bag suffers from constant rubbing with the robot movements which are some what avoidable. Further research of materials or a water proof stainless robot will improve this aspect.

- Upon completion of future development of automated and robotic systems to be installed at Peel Valley, the potential exists to provide a centralised SCADA package that will enable product integrity, down time, faults, and maintenance information to be displayed and recorded for production and maintenance staff.

- Further investigation and development is required to improve support system for cables and hoses attached to the manipulator. This will increase longevity of possible wear items such as bags and hoses.

- Further development may be required at Peel Valley to change the Vac San Path based upon results to be obtained from further Swab testing due Sept 2008 and to be completed by Peel Valley.

MAR Project Team

Name	Title	Responsibility	Email Address
Aaron Dowling	Project Manager	Project Manager	adowling@machineryautomation.com.au
Stuart Shaw	Innovations Manager	Innovations Manager	sshaw@machineryautomation.com.au
Steve Collum	Engineering Manager	Engineering Manager	scollum@machineryautomation.com.au
John Hui	Mechatronic Engineer	Mechanical Design	jhui@machineryautomation.com.au
Roland Painter	Mechatronic Engineer	Mechanical Design	rpainter@machineryautomation.com.au

Other Project Contacts

Name	Title	Organisation	Email Address
David Doral	Technology Manager	MLA	ddoral@mla.com.au
John McCluskey	Plant Manager	Peel Valley Exporters	jam@countryfresh.com.au
Brain Ghangurgh	QA Manager	Peel Valley Exporters	
Grant Edmonds	Managing Director	Burrangong Meat Processors	

Attachments

Attachment Number	Description
1	Production Video

Questions/Feedback

For any questions or feedback on this report please contact:

Stuart Shaw
Innovations Manager
Machinery Automation and Robotics
Office Phone: +612 9748 7001
Fax: +612 9748 7676
Mobile Phone: +61 (0)423029545
Email: sshaw@machineryautomation.com.au

OR

Aaron Dowling
Project Manager
Machinery Automation and Robotics
Office Phone: +612 9748 7001
Fax: +612 9748 7676
Mobile Phone: +61 (0)421 087 553
Email: adowling@machineryautomation.com.au

Feedback

Name	Comment / Feed Back