AMPC
AUSTRALIAN MEAT PROCESSOR CORPORATION

Shadow robotics

Remote Operations – Mimeo Shadow Robots (Stage 3+)

Project Code	Prepared by	Date Submitted
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Project Description

Shadow robotics offers the potential to remove operational staff from potentially dangerous devices or tasks. With the technology, ultimately, operational staff could be remote from the processing facility, thus creating a safer working environment. Additional benefits to using shadow robotic systems would be using them to remove the physical demands of some tasks and the added precision of industrial robots giving potential yield increases.

The purpose of this project was to progress the previous development of a proof-of-concept shadow robot system (Mimeo Industrial Ltd., 2022a; Mimeo Industrial Ltd., 2022b; Mimeo Industrial Ltd., 2022c) to a production prototype system trialled within a meat processing facility. Previous work yielded a prototype system that would monitor the real time motion of an operator (using a tracked object held by the operator) and "shadow" the operator's motion using an industrial robot arm.

This project takes this proof-of-concept system and (with additional development) applied it to an application in a processing facility. Thus, progressing the shadow robot system down the path to full implementation within a production environment.

Project Content

The objectives were to:

- Work with the industry to identify applications with a good return on investment.
- Continue the development of the shadow robot platform by adding:

  o   an end-effector and
  o   a conveyor-picking/in-feed singulation system

- Progress the shadow robot platform and tailor for two specific applications, effectively giving us a production prototype.
- Test a production prototype on site.

Project Outcome

After a workshop with a processor, two applications were chosen: the picking of lamb cuts from a conveyor and lamb hock cutting. To meet the requirements of these applications the existing industrial robot, a machine vision camera and proprietary Mimeo software were extended and complemented by:

- appropriate end effectors:
  o   compliant gripping devices for picking,
  o   industrial hock cutter for cutting,
- further machine vision and user interface work,
- a generic robot base and mounting that minimised floor space, and
- a safety system to enable a low intrusion installation into existing processes.

Site trials were conducted in October and December of 2023. The October site trip covered installation in the two locations at the targeted processing. For the

Photo of the shadow robot and associated base where the pedestal cabinet and outrigger legs are visible.

conveyor-picking boning-room application, after commissioning the system was evaluated for pick rate, ease of install and remote usability. For the hock cutting, slaughter-floor application it was deemed too risky to production to progress commissioning without further modifications to the plant. December trials focused on refinements to conveyor picking for different cuts e.g. orientation and gripping.

The trials showed the system was easy to install, required minimal floor space, did not intrude into walkways, and could be operated remotely (even internationally), and is safe to operate around other staff members. Between 10-20 different people operated the system through a remote interface. The rate of successful picks from the lamb trial was 79% (excluding operator error) at an average of 11.6 picks per minute.

The success rate of picking during the in-plant trials was less than the 30 parts per minute from controlled trials in the workshop prior to going to site. The main contributor to the difference was the more complex operating environment (in the workshop we managed the flow of product). In the trials, priority was given to demonstrating key features and general functionality of the system in a production environment. Nevertheless, the trials provided useful preliminary performance metrics that will be used to guide future refinements of the system.

The remote, operator-controlled shadow robot picking from a conveyor belt.

The shadow robot in the boning room working alongside staff.

During Stage 3+ of the Shadow Robotics initiative, the prototype multifunctional workshop system was developed into a pre-production unit. Key features of the shadow robot system are:

- remote operation through a website on any internet enabled device,
- mobile robot base with a small footprint,
- quick and easy installation without the need for permanent fixings and major site modifications,
- a core system adaptable to different applications (picking, cutting, trimming),
- operator assisted capabilities,
- conveyor/chain tracking/mapping,
- custom lens design for wider field of view,
- fully Wi-Fi with wireless camera tracking,

- custom workspaces and collision avoidance,
- plug and play design (only air supply and domestic power required),
- fenceless robot operation around operational personnel, and
- washdown.

Benefit for Industry

The goal was to have the building blocks for an early version (1.0) of a commercial system. That is, we would have designed, built, installed, and tested a production prototype in a boning room for at least one specific application, progressing the shadow robot system down the path to commercial use in meat processing facilities. This has been achieved.

The project has demonstrated the potential for shadow robotics to facilitate a different way of working, which can be described as anybody, anywhere, any time. That is, with shadow robotics, 'anybody' can take on any task be it physically demanding or potentially hazardous, and with remote control of the robot the work can be conducted from 'anywhere' (e.g. an office, distant from the boning room with no need to meet food handling requirements) and shifts can look quite different to today, hence 'anytime', with operators potentially logging in/out.

Photo showing an operator selecting parts for the robot to pick from the conveyor. Here the shadow robot operator is in the boning room but remote from the robot.

Photo showing the shadow robot located in the boning room, being operated remotely, from an office. A potentially new way to work.