Snapshot Report

Snapshot

Identification of Naked Racks Using Machine Learning Algorithms

Project Code	Prepared by	Date Submitted
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Project Description

This project concerns the development of algorithms, software and machine learning models to identify naked lamb rack primals on an abattoir conveyor belt at chain speed. The automated identification of these primals has the potential to offer significant advantages to processors in terms of product reliability and reduced labor costs, and would additionally represent a strong foundation on which the development of related models and systems could be based for other applications relevant to meat processors. The outlined objectives of the project were:

- To produce a labelled dataset consisting of 30,000 images of naked lamb racks.
- To develop a machine learning model that is able to identify a naked lamb rack on the GMP boning belt with 99.9% accuracy at chain speed.
- To develop a machine learning system that can alert a nearby user if the model is unsure, allowing for manual override.

Project Content

This project had several processes to allow for the development of the final machine learning algorithms for the detection of naked lamb racks. The initial phase included data collection, first manually by human operators and then by the modular camera system with automation, to build a high quality dataset which was used for model training, and analysis. Data labelling began in this phase, both manual and computer-assisted on collected images, annotating the correct locations and identifies of lamb primals. Once bulk data capture and labelling had occurred, machine learning model development followed, focusing on training an algorithm to recognise naked lamb rack primals in images. Further development and implementation of algorithms occurred in model output post-processing, using the machine learning model's predictions to utilise images taken across time and from multiple camera angles to enhance the system's overall accuracy at identification of naked lamb rack primals. The final phase was system validation and evaluation, where a scheme was designed and implemented to quantitatively evaluate the accuracy of the system at the identification of naked lamb rack primals and to ensure it meets the project objectives.

Project Outcome

The project attempted to satisfy three objectives, and each as achieved successfully:

- A labelled dataset consisting of 30,000 images of naked lamb racks was collected.
- A machine learning model that is capable of identifying a naked lamb rack on the GMP boning belt with 99.9% accuracy at chain speed was developed. A comprehensive evaluation scheme was designed and implemented to measure the accuracy of, and the system's accuracy at identifying more than 1000 naked lamb racks across the evaluation dataset was found to be 99.9%
- A sophisticated touch-screen graphical interface was developed for the system and tested to ensure that it is able to display relevant information about system operation to the user, able to alert the user to low-confidence detections, and allow the user to override the system if needed (see *Figure 1*).

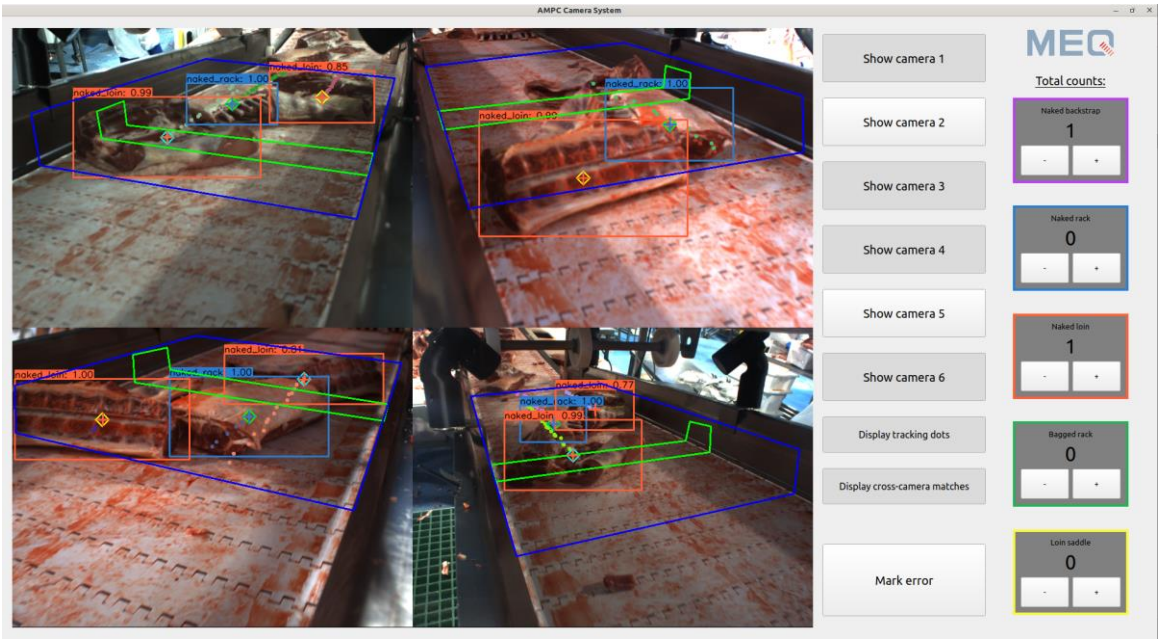

Figure 1: Screen capture of GUI frontend running in a mode designed to display the total counts of each class of object that has passed by the system during the current session along with information about the system's operation, and allow the user to override the count if necessary.

Benefit for Industry

The success of this project provides strong evidence for the applicability of computer vision and machine learning techniques in the abattoir boning room, and we would recommend that further research and development be undertaken to bring these technologies to bear in further applications which have direct and specific benefit to processors. In our opinion, these technologies could have immediate value in the following areas:

- Automatic Sorting: a machine learning/computer vision system could be developed to control mechanical systems such as belt diverters to enable automated sorting of meat cuts in certain situations.
- Supply Chain Traceability: with some expansion of scope, potentially including more cameras and processing nodes, the technologies used in this project could be applied to the problem of boning room traceability to track an individual carcase as it is transformed into primals and individual cuts.
- Quality Assurance: a machine learning/computer vision system could be developed to identify and count objects once boxed, and alert users to the presence of foreign objects

Useful resources

Not applicable.