Automated Detection and Removal of Flawed Ready-to-Eat Chicken Wings in a Industrial Setting

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Problem Statement

One of the largest problems impacting the food processing industry is ensuring consistently quality products. This is especially problematic in high risk chicken products in which defective products are very difficult to spot by vision alone, as throughput and variation in individual products is very high. Defects include exposed bone and feathers on Ready-to-Eat chicken wings.

Objective

1. Thermal Camera System

A thermal imaging system is to be implemented above a conveyor line that is carrying chicken wings out of an industrial oven. This camera will record the conveyor and chicken wings as they move, sending the information to a computer.

2. Computing system

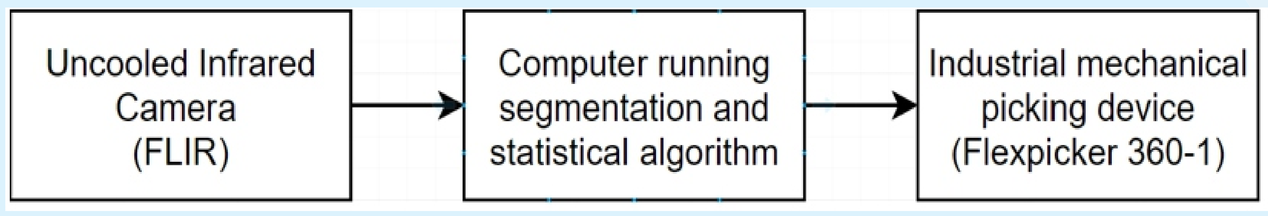
The live thermal video will be used as the input in a segmentation Python script, with the objective being to place a boundary around each wing. The script stores the temperature data for every pixel within the boundary and performs simple statistical analysis to determine which chicken wings do not meet requirements.

3. Mechanical Picker

A controllable mechanical defect picker (Flexpicker 360-1) receives the location data for each wing deemed defective and will remove them from the line as they come down.

Background

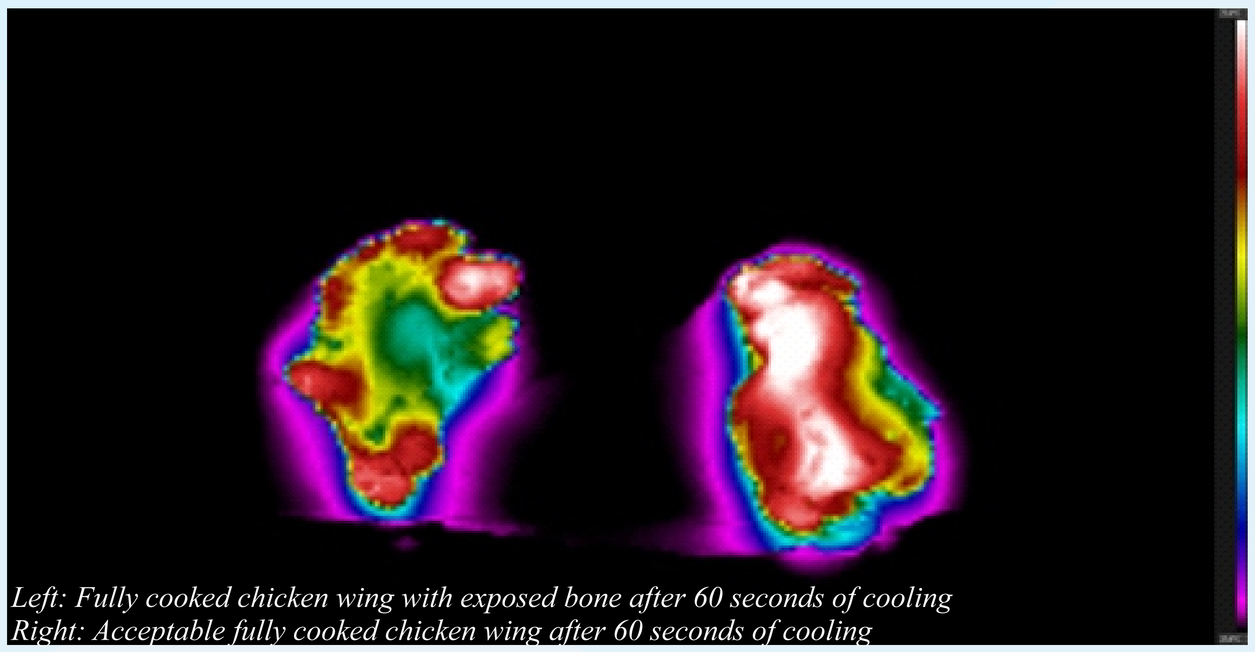
Grand River Foods produces a variety of Ready-to-Eat chicken products for large restaurant and grocery chains who require consistently quality products. The removal of chicken wings with exposed bone and feather by humans is very difficult requires many employees.



Methodology

- Chicken wings were cooked in an oven to an internal temperature of 165 degrees F, and were placed on a table in the middle of the thermal camera's view. Images were taken every 15 seconds as the wings cooled. This process was repeated 50 times for acceptable wings, wings with exposed bone, and wings with visible feathers attached the skin.

- Images were analyzed in FLIR tools to determine the differences between the three batches. This data was collected and analyzed in MATLAB to determine the differences in samples. Variance in temperature within the boundary was calculated for each photo.



Left: Fully cooked chicken wing with exposed bone after 60 seconds of cooling
Right: Acceptable fully cooked chicken wing after 60 seconds of cooling

Conclusion

Chicken wings with aberrations were found to show a greater variance in measured temperature than acceptable wings with no flaws, especially due to exposed bone which presents a lower temperature profile in comparison to unperforated skin and muscle and can be detected for removal. With further testing and improvements of the computer vision program and mechanical picker, operations may be optimized to improve detection speed, accuracy and subsequent removal of flawed products.

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