

ABSTRAK

Peningkatan kebutuhan pelanggan terhadap efektivitas dan efisiensi layanan mendorong berkembangnya teknologi otomatisasi, salah satunya Self-Service Technology (SST). Dalam konteks rumah makan prasmanan, proses perhitungan makanan sering dilakukan secara manual sehingga dapat menyebabkan kesalahan perhitungan, antrean panjang, serta kurang efisiennya proses pelayanan. Oleh sebab itu, dibutuhkan pendekatan yang sanggup mendeteksi dan mengelompokkan makanan secara otomatis agar proses perhitungan menjadi lebih cepat dan akurat. Penelitian ini bermaksud untuk menguji kemampuan deteksi dan pengelompokan makanan menggunakan kombinasi model YOLOv8-seg sebagai metode deteksi objek serta algoritma Ray-Casting untuk menentukan hubungan spasial makanan terhadap wadahnya. Studi kasus penelitian dilakukan pada rumah makan prasmanan Haji Sumi.

Metode penelitian diawali dengan pengumpulan data primer dan sekunder. Tahapan preprocessing meliputi pembersihan data, anotasi, pembagian data, resize, serta augmentasi data. Selanjutnya dilakukan pelatihan model YOLOv8-seg untuk mendeteksi objek makanan dan wadah, kemudian diterapkan algoritma Ray-Casting untuk menentukan apakah objek makanan berada di dalam suatu wadah. Data sekunder sebanyak 4068 gambar digunakan sebagai pre-trained dataset, sedangkan data primer sebanyak 3264 gambar digunakan untuk proses fine-tuning. Untuk pengujian sistem, digunakan 360 gambar data primer yang mewakili berbagai variasi kondisi jumlah wadah dan tingkat *overlapping*. Kinerja model dievaluasi menggunakan metrik recall, precision, dan mAP.

Hasil penelitian menunjukkan bahwa model YOLOv8-seg mampu mendeteksi objek makanan dan wadah dengan baik pada sistem self-service prasmanan. Pengujian model menggunakan parameter epoch 50, learning rate 0.001, batch size 8, serta IoU 0.7 menghasilkan nilai precision sebesar 83.7%, recall sebesar 79.6%, mAP@50 sebesar 82.1%, dan mAP@50–95 sebesar 58.4%, dengan peningkatan sebesar 39.7% pada mAP@50–95 dibandingkan model baseline. Hasil confusion matrix menunjukkan bahwa sebagian besar objek makanan berhasil dideteksi dengan benar, terutama pada kondisi non-overlapping, meskipun pada kondisi overlapping masih ditemukan beberapa kesalahan klasifikasi dan objek yang tidak terdeteksi akibat objek saling bertumpang tindih. Selain itu, algoritma Ray Casting mampu mengelompokkan objek makanan yang berhasil dideteksi ke dalam wadah yang sesuai dengan tingkat akurasi F1-Score sebesar 86%. Implementasi sistem secara real-time menggunakan kamera sebagai input utama juga berhasil dilakukan, di mana sistem mampu menampilkan hasil deteksi, segmentasi, dan pengelompokan objek makanan secara langsung pada antarmuka aplikasi. Dengan demikian, kombinasi YOLOv8-seg dan algoritma Ray Casting dinilai efektif untuk mendukung otomatisasi identifikasi dan pengelompokan makanan pada layanan self-service prasmanan secara real-time.

Kata Kunci: Deteksi Makanan, Pengelompokan Makanan, YOLOv8, Algoritma Ray-Casting, Makanan Prasmanan

ABSTRACT

The increasing demand for service effectiveness and efficiency has driven the development of automation technologies, one of which is Self-Service Technology (SST). In the context of buffet restaurants, the process of calculating food items is often performed manually, which may lead to calculation errors, long queues, and inefficient service processes. Therefore, a system that can automatically detect and group food items is needed to make the calculation process faster and more accurate. This study is intended to assess the performance of a food detection and grouping technique using a combination of the YOLOv8-seg model as an object detection method and the Ray-Casting algorithm to determine the spatial relationship between food items and their containers. The case study of this research was conducted at the Haji Sumi buffet restaurant.

The research process started with the gathering of both primary and secondary data. The preprocessing stage included data cleaning, annotation, dataset splitting, resizing, and data augmentation. Subsequently, the YOLOv8-seg model was trained to detect food objects and containers, followed by the implementation of the Ray-Casting algorithm to identify whether a food object is located within a specific container. A total of 4068 secondary images were used as the pre-trained dataset, while 3264 primary images were utilized for the fine-tuning process. For system evaluation, 24 primary images representing various scenarios of container quantities and overlapping conditions were tested using the developed system. The model's performance was assessed using recall, precision, and mAP.

The research indicates that the YOLOv8-seg model is capable of detecting food objects and containers effectively in a self-service buffet system. Model testing using parameters of 50 epochs, a learning rate of 0.001, a batch size of 8, and an IoU threshold of 0.7 achieved a precision of 83.7%, recall of 79.6%, mAP@50 of 82.1%, and mAP@50–95 of 58.4%, representing an improvement of 39.7% in mAP@50–95 compared to the baseline model. The confusion matrix results show that most food objects were successfully detected correctly, particularly under non-overlapping conditions, although several misclassifications and undetected objects were still found under overlapping conditions due to object occlusion. In addition, the Ray Casting algorithm was able to group detected food objects into the appropriate containers with F1-Score an accuracy rate of 86%. The real-time system implementation using a camera as the primary input was also successfully conducted, where the system was able to display detection, segmentation, and food object grouping results directly through the application interface. Therefore, the combination of YOLOv8-seg and the Ray Casting algorithm is considered effective in supporting automated food identification and grouping in a real-time self-service buffet system.

Keywords: *Food Detection, Food Grouping, YOLOv8, Ray-Casting Algorithm, Prasmanan Food*