Detection of Expiration Dates in Product Images Using YOLO

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Abstract. *Accurate identification of expiration dates on product packaging is essential to prevent the consumption of expired goods, reduce waste, and improve inventory management. This study proposes a YOLO-based neural network model for automatic detection of expiration dates in product packaging images. A dataset containing 668 images of Brazilian product packages was created, annotated, and made publicly available for training and evaluation purposes. Our fine-tuned YOLO achieved a precision of 0.804 and an F1-score of 0.812, indicating promising results for expiration date detection.*

1. Introduction

Expiration dates are essential for ensuring food safety, reducing waste, and supporting efficient supply chain management. In Brazil, more than 27 million tons of food are discarded every year, with a large share of this waste linked to poor control of expiration labeling [ABRAS 2022]. Automated detection of expiration dates on packaging could mitigate these losses, protecting public health while also for minimizing financial losses and enhancing logistical efficiency.

Expiration date detection remains a challenging task because dates appear in multiple formats, use varying fonts, sizes, and colors, and are often placed in inconsistent positions across packaging. These conditions limit the reliability of OCR-based methods, which require clean, well-aligned inputs [Hosozawa et al. 2018, Scazzoli et al. 2019].

Recent works have explored deep learning approaches that combine text detectors and recognizers [Rebedea and Florea 2020, Gong et al. 2021, Seker and Ahn 2022], but most focus on European or Asian datasets and lack adaptation to Brazilian packaging, where abbreviations and Portuguese month names add complexity that must be considered during detection. To address this gap, we propose a YOLO-based single-stage detector trained on a novel dataset of 668 annotated Brazilian product images. Our contributions include (1) the creation of this publicly available dataset, and (2) the fine-tuning of YOLOv5, achieving results in expiration date detection under real-world conditions.

2. Materials and Methods

It is important to clarify that this work does not aim to recognize the textual content of expiration dates directly, but rather to detect the region of the package where the expiration date is located in Brazilian product packaging - see Figure 1(a). For this purpose, our goals are: (1) to construct and annotate a dataset of packaging images containing expiration date information; (2) to fine-tune a YOLO model on this dataset for date detection; (3) to evaluate the model's performance on unseen data and compare it to the Detector from [Seker and Ahn 2022].

Dataset: A custom dataset of 668 images was collected in Brazilian supermarkets using smartphones under real-world conditions, capturing diverse packaging designs, lighting variations, and expiration date formats. Annotations followed the schema of [Seker and Ahn 2022], with four classes: *date*, *code*, *prod*, and *due* - see Figure 1(b). To reflect realistic scenarios, the dataset includes a variety of numeric and textual formats (e.g., 10/03/25, MAR 2025), as well as background-only samples to reduce false positives during training. Our dataset is publicly available[1] and can be exported in multiple formats (e.g., YOLO, COCO, VOC), supporting reproducibility and further research.

(a) Region of expiration date detection example (b) Annotations made on Roboflow

Figure 1. Samples images from dataset.

Model and Training: YOLOv5s[2] (the *small* version of YOLOv5) was chosen for its performance and suitability for small datasets via transfer learning. Two training setups were tested: one without augmentation and one with augmentations to improve model generalization - using the following hyperparameters values: *scale* (0.5), *perspective* (0.0), *mosaic* (1.0), *mixup* (1.0), *copy_paste* (1.0), *hsv_h* (0.015), *hsv_s* (0.7), and *hsv_v* (0.4). Models were evaluated on *Precision*, *Recall*, *F1-score*, *Intersection over Union (IoU)* and compared to the Baseline Detector [Seker and Ahn 2022], which was not retrained on our dataset, ensuring a fair comparison focused solely on the *date* class.

3. Results

Experiment 1: Model Without Augmentation The YOLO based model trained without data augmentation achieved its best performance at epoch 204. The highest F1-score for all classes was 0.72 at a confidence threshold of 0.398. Figure 2(a) illustrates the F1-score behavior as the confidence threshold changes, with an Intersection over Union (IoU) threshold fixed at 0.6. The *date* class, the focus of this study, obtained the highest individual F1-score among all classes. Table 1 shows the confusion matrix, along with *Precision*, *Recall*, and *F1-score*.

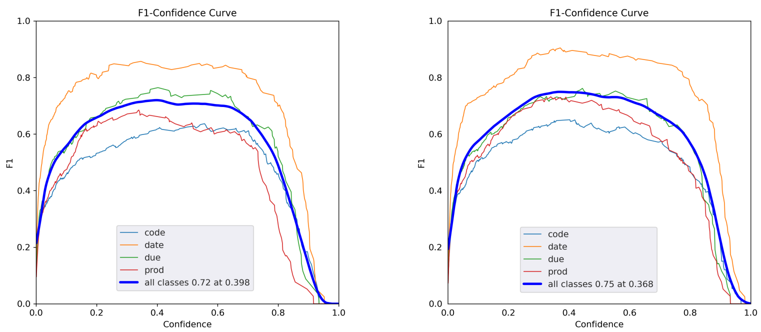
Experiment 2: Model With Augmentation In the second experiment, the model trained with data augmentation reached its best performance at epoch 300. This result suggests that augmentation helped sustain learning across epochs, preveting premature convergence. The model with augmentation achieved an overall F1-score of 0.75 at a confidence threshold of 0.368 - see figure Figure 2(b), notably higher than the baseline without augmentation, which peaked at 0.72.

The confusion matrix, shown in Table 2, reveals consistent gains in both precision and recall across nearly all classes. Most importantly, the *date* class, our primary target,

[1]https://universe.roboflow.com/tcc-xrqer/products-expiration-dates
[2]https://github.com/ultralytics/yolov5

Table 1. Confusion Matrix and Metrics – No Augmentation

		Ground Truth					Metrics		
	Class	code	date	due	prod	bg	Precision	Recall	F1-score
Predicted	code	**0.56**	0.07	0.01	0.01	0.58	0.655	0.504	0.569
	date	0.07	**0.64**	0.00	0.00	0.15	0.833	0.622	0.712
	due	0.00	0.00	**0.62**	0.01	0.05	0.952	0.571	0.713
	prod	0.04	0.00	0.03	**0.49**	0.22	0.783	0.443	0.565
	bg	0.33	0.29	0.33	0.49	**0.00**	-	-	-



(a) Without Augmentation (b) With Augmentation

Figure 2. Comparison of validation F1 Score vs. Confidence curves.

benefited significantly from the augmentation strategies, reaching an F1-score of 0.812 - a 10-point gain over the baseline. These results confirm that the data augmentation techniques applied not only helped the model generalize better but also reduced overfitting to specific visual patterns found in the training data. Taken together, these findings validate the use of data augmentation as an effective strategy for improving expiration date detection in real-world Brazilian packaging, and demonstrate its value in settings where large-scale annotated datasets are not available.

Table 2. Confusion Matrix and Metrics – With Augmentation

		Ground Truth					Metrics		
	Class	code	date	due	prod	bg	Precision	Recall	F1-score
Predicted	code	**0.68**	0.04	0.01	0.01	0.52	0.656	0.661	0.658
	date	0.03	**0.83**	0.00	0.00	0.17	0.804	0.822	0.812
	due	0.00	0.00	**0.65**	0.01	0.09	0.865	0.652	0.743
	prod	0.01	0.00	0.03	**0.69**	0.22	0.805	0.705	0.751
	bg	0.28	0.12	0.33	0.28	**0.00**	-	-	-

Experiment 3: Comparison With Detector To contextualize performance, we compared our YOLO model with the detector proposed by [Seker and Ahn 2022], which relies on multiple networks and does not include Brazilian packaging in its training set. As shown in Table 3, our fine-tuned YOLO achieved higher precision, recall, F1-score,

IoU, and Dice, confirming the benefits of domain-specific data and the efficiency of a single-stage detector over more complex pipelines.

These results highlight two important insights. First, training object detectors with data tailored to the target domain (in this case, Brazilian packaging expiration dates) yields significant improvements in both detection accuracy and robustness. Second, a single-stage detector like YOLO can deliver superior performance with a more streamlined pipeline, bypassing the need for multiple neural networks and complex post-processing stages, as required by the method in [Seker and Ahn 2022].

Table 3. Comparison between Detector and YOLO (with Data Augmentation)

Model	Precision	Recall	F1-score	Mean IoU	Mean Dice
Detector	0.628	0.488	0.550	0.759	0.857
YOLO (Ours)	**0.771**	**0.788**	**0.780**	**0.815**	**0.894**

4. Conclusion

This work addressed the expiration date detection task by introducing a dataset of 668 annotated images from Brazilian supermarkets and training a YOLOv5 model to identify expiration date regions, which achieved an F1-score of 0.812 for the *date* class, outperforming the previous work of the Detector by 0.23 points. These results demonstrate that robust detection is possible even with limited data. Future work could extend both our dataset and our model to include character recognition within the detected regions, completing the end-to-end automation of expiration date extraction.

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