EasyChair Preprint

№ 10546

Using Yolo V7 to Detect the Health and Quality of Fruits

Theodore Aditya Oei, Marcelius Surya Wijaya,
Johannes Batistuta Simanjuntak,
Erna Francisca Angela Sihotang and Edy Irwansyah

July 12, 2023

Using Yolo V7 to Detect the Health and Quality of Fruits

Theodore Aditya Oei
School of Computer Science
Bina Nusantara University
Jakarta, Indonesia
theodore.oei@binus.ac.id

Marcelius Surya Wijaya
School of Computer Science
Bina Nusantara University
Jakarta, Indonesia
marcelius.wijaya@binus.ac.id

Johannes Batistuta Simanjuntak
School of Computer Science
Bina Nusantara University
Jakarta, Indonesia
Johannes.batistuta@binus.ac.id

Erna Fransisca Angela Sihotang
Statistic Department,
School of Computer Science
Bina Nusantara University
Jakarta, Indonesia
erna.sihotang@binus.edu

Edy Irwansyah
Computer Science Departmenet
School of Computer Science
Bina Nusantara University
Jakarta, Indonesia
eirwansyah@binus.edu

***Abstract*— This study explores the potential of YOLOv7 in detecting the health and quality of fruits. The aim is to develop a dependable automated system that can detect the quality and safety of fruits to ensure that only the best and safest fruits are delivered to consumers. The methodology involves linking YOLOv7 with image enhancement techniques for efficient fruit detection and classification. The performance of YOLOv7 is evaluated in detecting the health and quality of fruits using a specifically designed dataset. Results show that YOLOv7 has an accuracy of 83.5% in detecting fresh and rotten apples, indicating its potential as a useful tool in the fruit management industry. The high accuracy rate in detecting fruit quality can improve the efficiency of fruit sorting and grading, leading to higher productivity and better quality final products. Future research can focus on optimizing the algorithm for specific use cases and validating its performance in other scenarios. Overall, this study demonstrates the potential of YOLOv7 in fruit detection and classification.**

Keywords—Yolo, Object Detection, Fruit Detection, Agriculture Technology, Convolutional Neural Networks, Computer Vision, Image Processing

I. INTRODUCTION

There has been an ever increasing worry regarding the quality and safety of the fruits that people consume. The concern has emerged due to the use of harmful substances and chemicals such as pesticides and additives by fruit sellers to make fruits more visually appealing in order to ramp up sales. However, manually inspection of each fruit is a time-consuming and laborious process, which can delay the distribution process. Therefore, the need for an effective and dependable automated system that can detect the quality and safety of fruits emerges, to ensure that only the best and safest fruits are delivered to consumers.

The aim of this study is to explore the potential of YOLOv7 in detecting the health and quality of fruits. Various image enhancement techniques will be investigated to improve the accuracy of YOLOv7 in fruit detection. A methodology will be developed to link YOLOv7 with image enhancement techniques for efficient fruit detection and classification. Finally, the performance of YOLOv7 will be evaluated in detecting the health and quality of fruits by conducting experiments using a specifically designed dataset for this exact purpose. The study aims to offer insights for improving the performance of YOLOv7 in fruit detection and classification.

II. LITERATURE REVIEW

Detailed literature review papers can be seen in the following table (Table 1)

No.	Title	Method/ Algorithm	Conclusion
[1]	The development of object recognition requires experience with the surface features of objects	Conducting the experiment several times and seeing the changes	The development of object recognition requires experience with the surface features of objects.it is possible to control and manipulate all of the chicks
[5]	Tomato Diseases and Pests Detection Based on Improved Yolo V3 Convolutional Neural Network	Scanning tomato by using yolo V3	The detection accuracy of the algorithm is 92.39% and the detection time is only 20.39 ms.
[19]	Detection of Cherry Quality Using YOLOV5 Model Based on Flood Filling Algorithm	Training the models using dataset extracted by flood filling algorithm	When trained using the dataset that was extracted by the flood filling algorithm, the accuracy from the testing they conducted yielded significantly higher results than just using the un-extracted raw dataset.
[27]	Automated apple defect detection using state-of-the-art object	Automatic apple defect detection	The results between YOLO and SSD were comparable, but both can be further improved

	detection techniques	using YOLOv2	
[29]	Fruit Classification Comparison Based on CNN and YOLO	Object Detection using YOLO and CNN	The study proposed using modern techniques in deep neural networking, such as CNN and YOLO, for fruit classification in agriculture
[30]	The study proposed using modern techniques in deep neural networking, such as CNN and YOLO, for fruit classification in agriculture	Fruit Detection Using YOLO, Real Time Fruit Counting Using YOLO and an Object Tracking Algorithm	The study aimed to develop a real-time fruit counter for mobile applications using only RGB data, YOLOv4, and Deep SORT. YOLOv4-CSP was found to be the optimal model in terms of accuracy, with an AP@0.50 of 98%.

Table 1. Literature Review Table

Object detection algorithms, notably YOLO algorithms, have been rapidly developed and applied throughout the years. This literature review focuses on developing these algorithms to meet the specific use case of detecting health and quality of fruits.

Justin and Samantha Wood's journal[1] states that visual experience (mainly surface features of objects) plays a big role in developing object recognition tech. This helps set a tempo for the literature review as it plays a role as the basis for developing object recognition. Liu, J. and Wang, X.[5] detected tomato diseases and pests using YOLOv3 maybe the most similar study to ours in terms of goals. Their findings suggest that YOLOv3 can be used for detecting anomalies and deficiencies in agricultural products within real world conditions, also highlighting the importance of developing object detection algorithms for quality control for products within the agricultural industry, such as tomatoes.

In a study by Siddiqi, [27] the researcher proposed to use advanced object detection techniques for automatic apple defect detection because of achieving high accuracy in apple fault detection. In Journal Raj et al. [29] compared fruit classifications using CNN and YOLO. The result of the study is that YOLO is a better algorithm than CNN for classifying fruits based on image features. Meanwhile, Parico and Ahamed [30] used the YOLOv4 and Deep SORT algorithms to detect and count pear fruits in real time. In Journal Zhu et al. [19] Detected Cherry Quality Using YOLOV5 Model and using flooding filling algorithm and obtained 99.6% accuracy.

In summary, object detection algorithms particularly YOLO, have shown great potential in detecting fruit imperfections such as anomalies, deficiencies, and diseases. These studies demonstrate how useful YOLO can be in enhancing object detection and classification, including evaluating the freshness of fruits and vegetables. By utilizing YOLO V7 and exploring different approaches, researchers can detect the health and quality of fruits, possibly deploying it into an actual tool that farmers can use to increase their produce.

III. Methodology

Object detection algorithms, especially YOLO, have shown great potential in detecting fruit imperfections such as anomalies, deficiencies, and diseases. These studies have demonstrated how useful YOLO is in enhancing object detection and classification, including evaluating the freshness of fruits and vegetables. However, many fruit producers in environments with limited knowledge of modern technology still manually evaluate the quality of fruit, which slows down production and requires experienced experts or farmers.

Therefore, in this research, we will use YOLOv7, a deep neural network algorithm, to accelerate the process of assessing fruit quality and improve detection accuracy. With YOLOv7's ability to analyze images in real-time, this algorithm is highly suitable for use in the fruit management industry to detect good fruit without requiring an expert. Thus, this research will discuss how YOLOv7 can be used to sort good and bad fruit with high speed and accuracy, making it easier for people to assess the quality of the fruit.

A. Workflow

In this research, the method used is Systematic Literature Review to conduct research and experiments by collecting datasets, reviewing the datasets, and inputting the datasets for experimentation. In the experiment, all datasets are inputted into Roboflow, which will then be inputted into YOLOv7 and trained.

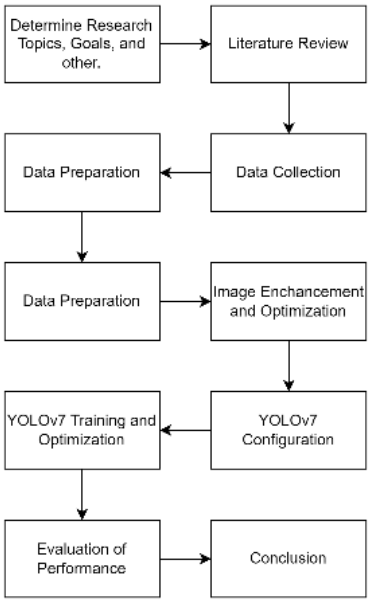

Figure 1. Workflow

B. Dataset

The dataset used is an apple fruit dataset. The dataset is divided into 2 parts, namely photos of rotten apples and photos of fresh apples. The dataset contains 2544 apple fruit photos that have been selected and cropped to be inputted into Roboflow

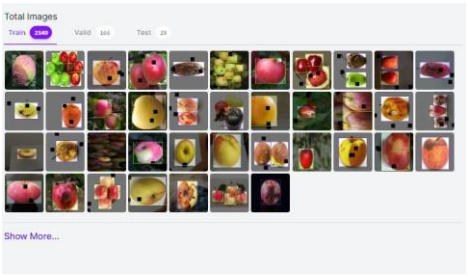

Figure 2. Dataset for Train, Valid, and Test

IV. RESULT

A. Testing and Training Model

From the prepared dataset (Figure 2), the dataset is divided into 3 parts where 2349 photos are used for training, 166 photos for validation, and 29 photos for testing. The dataset is inputted into Roboflow and undergoes preprocessing and augmentation.

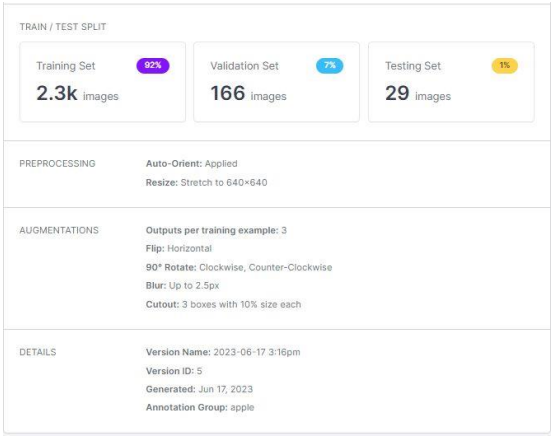

Figure 3. Detail of preprocessing and augmentation

After obtaining the API from Roboflow and inputting it into Google Colab for training in YOLOv7, testing was then performed on the provided photos, and the result was an 84% accuracy from YOLOv7.

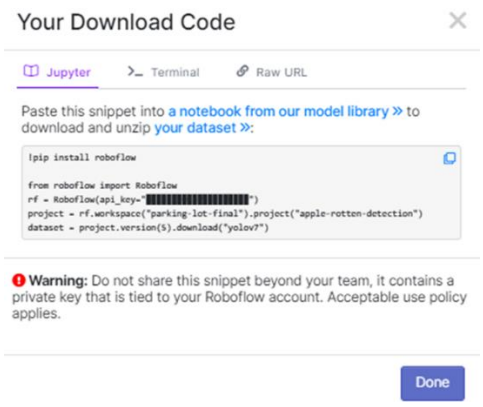

Figure 4. Obtaining API Roboflow

B. Accuracy

After the training process, it was found that YOLOv7 had an accuracy of 83.5% in detecting rotten and fresh apples (Table 2). This result shows that YOLOv7 has the potential to be a useful tool in the fruit management industry. The high accuracy rate in detecting fruit quality can help increase the efficiency of fruit sorting and grading, leading to improved productivity and quality of the final products.

Class	Images	Labels	P	R	mAP@.5	mAP@.5:.95:
All	166	285	0.743	0.79	0.835	0.754
fresh_apple	166	140	0.742	0.843	0.866	0.78
rotten_apple	166	145	0.743	0.737	0.804	0.727

Table 2. YOLOv7 Train Result

C. Result

From the YOLOv7 training results, testing was conducted to determine whether the provided photos of apples could be detected accurately and whether the algorithm could distinguish between fresh and rotten apples.

Figure 5. Detection results by YOLOv7

Figure 6. Detection results by YOLOv7

V. CONCLUSION

In conclusion, this research successfully implemented YOLOv7 to detect fresh and rotten apples with an accuracy of 83.5%. The high accuracy rate of YOLOv7 in detecting fruit quality has the potential to revolutionize the fruit management industry by improving the efficiency of fruit sorting and grading, leading to higher productivity and better quality final products.

However, further research is required to optimize the algorithm for specific use cases and to validate its performance in other scenarios. Overall, the results obtained in this study demonstrate the potential of YOLOv7 as a useful tool in the fruit management industry and pave the way for further research in this area.

REFERENCES

[1] J. N. Wood and S. M. W. Wood, "The development of object recognition requires experience with the surface features of objects", doi: 10.1101/2022.12.30.522302.

[2] Y. Cao, C. Li, Y. Peng, and H. Ru, “MCS-YOLO: A Multiscale Object Detection Method for Autonomous Driving Road Environment Recognition,” 2017.

[3] M. L. Francies, M. M. Ata, and M. A. Mohamed, “A robust multiclass 3D object recognition based on modern YOLO deep learning algorithms,” Concurr Comput, vol. 34, no. 1, Jan. 2022, doi: 10.1002/cpe.6517.

[4] D. Sari and A. Mirza, “THE DETECTION OF FACE RECOGNITION AS EMPLOYEE ATTENDANCE PRESENCE USING THE YOLO ALGORITHM (YOU ONLY LOOK ONCE),” 2022.

[5] J. Liu and X. Wang, “Tomato Diseases and Pests Detection Based on Improved Yolo V3 Convolutional Neural Network,” Front Plant Sci, vol. 11, Jun. 2020, doi: 10.3389/fpls.2020.00898.

[6] V. V, R. Ac, and C. R. K, “Real Time Object Detection System with YOLO and CNN Models: A Review”, doi: 10.37896/JXAT14.07/315415.

[7] F. Wan, C. Sun, H. He, G. Lei, L. Xu, and T. Xiao, “YOLO-LRDD: a lightweight method for road damage detection based on improved YOLOv5s,” EURASIP J Adv Signal Process, vol. 2022, no. 1, Dec. 2022, doi: 10.1186/s13634-022-00931-x.

[8] D. Maji, S. Nagori, M. Mathew, and D. Poddar, “YOLO-Pose: Enhancing YOLO for Multi Person Pose Estimation Using Object Keypoint Similarity Loss”.

[9] W. Liu, G. Ren, R. Yu, S. Guo, J. Zhu, and L. Zhang, “Image-Adaptive YOLO for Object Detection in Adverse Weather Conditions,” Dec. 2021, [Online]. Available: http://arxiv.org/abs/2112.08088

[10] Dr. S. Gothane, “A Practice for Object Detection Using YOLO Algorithm,” International Journal of Scientific Research in Computer Science, Engineering and Information Technology, pp. 268–272, Apr. 2021, doi: 10.32628/cseit217249.

[11] C. S. Kondapaneni, M. V. S. Teja, R. Kavuri, D. Tinnavalli, and S. Bano, “Implementing Spot the Differences Game Using YOLO Algorithm,” in Cognitive Science and Technology, Springer, 2022, pp. 707–719. doi: 10.1007/978-981-19-2350-0_67.

[12] F. Dang, D. Chen, Y. Lu, and Z. Li, “YOLOWeeds: A novel benchmark of YOLO object detectors for multi-class weed detection in cotton production systems,” Comput Electron Agric, vol. 205, Feb. 2023, doi: 10.1016/j.compag.2023.107655.

[13] K. M. Naing et al., “Automatic recognition of parasitic products in stool examination using object detection approach,” PeerJ Comput Sci, vol. 8, 2022, doi: 10.7717/PEERJ-CS.1065.

[14] N. Saini, S. Profile, K. Pham, and A. Shrivastava, “Disentangling Visual Embeddings for Attributes and Objects”, doi: 10.48550/arXiv.2205.08536.

[15] X. Shen, G. Shi, H. Ren, and W. Zhang, “Biomimetic Vision for Zoom Object Detection Based on Improved Vertical Grid Number YOLO Algorithm,” Front Bioeng Biotechnol, vol. 10, May 2022, doi: 10.3389/fbioe.2022.905583.

[16] C. Wu, Q. Luo, and D. Shou, “Image Recognition Technology and Development of YOLO Algorithm,” in Advances in Transdisciplinary Engineering, IOS Press BV, Dec. 2022, pp. 32–38. doi: 10.3233/ATDE221146.

[17] D. Wu et al., “Detection of Camellia oleifera Fruit in Complex Scenes by Using YOLOv7 and Data Augmentation,” Applied Sciences (Switzerland), vol. 12, no. 22, Nov. 2022, doi: 10.3390/app122211318.

[18] R. Khan and R. Debnath, “Multi Class Fruit Classification Using Efficient Object Detection and Recognition Techniques,” International Journal of Image, Graphics and Signal Processing, vol. 11, no. 8, pp. 1–18, Aug. 2019, doi: 10.5815/ijigsp.2019.08.01.

[19] W. Han, F. Jiang, and Z. Zhu, “Detection of Cherry Quality Using YOLOV5 Model Based on Flood Filling Algorithm,” Foods, vol. 11, no. 8, Apr. 2022, doi: 10.3390/foods11081127.

[20] N. A. E. Budiarti, S. Wahjuni, W. B. Suwarno, and Wulandari, “Research on Melon Fruit Selection Based on Rank with YOLOv4 Algorithm,” in Journal of Physics: Conference Series, IOP Publishing Ltd, Dec. 2021. doi: 10.1088/1742-6596/2123/1/012036.

[21] X. Wang and J. Liu, “Tomato Anomalies Detection in Greenhouse Scenarios Based on YOLO-Dense,” Front Plant Sci, vol. 12, Apr. 2021, doi: 10.3389/fpls.2021.634103.

[22] Z. Huang, P. Zhang, R. Liu, and D. Li, “Immature Apple Detection Method Based on Improved Yolov3,” ASP Transactions on Internet of Things, vol. 1, no. 1, pp. 9–13, May 2021, doi: 10.52810/tiot.2021.100028.

[23] P. Valdez, “Apple Defect Detection Using Deep Learning Based Object Detection For Better Post Harvest Handling,” May 2020, [Online]. Available: http://arxiv.org/abs/2005.06089

[24] M. Padma Reddy, “Mulberry leaf disease detection using YOLO,” 2021. [Online]. Available: https://www.ijariit.com

[25] C. B. MacEachern, T. J. Esau, A. W. Schumann, P. J. Hennessy, and Q. U. Zaman, “Detection of fruit maturity stage and yield estimation in wild blueberry using deep learning convolutional neural networks,” Smart Agricultural Technology, vol. 3, p. 100099, Feb. 2023, doi: 10.1016/j.atech.2022.100099.

[26] M. Mukhiddinov, A. Muminov, and J. Cho, “Improved Classification Approach for Fruits and Vegetables Freshness Based on Deep Learning,” Sensors, vol. 22, no. 21, Nov. 2022, doi: 10.3390/s22218192.

[27] R. Siddiqi, “Automated apple defect detection using state-of-the-art object detection techniques,” SN Appl Sci, vol. 1, no. 11, Nov. 2019, doi: 10.1007/s42452-019-1393-4.

[28] S.-H. Lee, “A Study on Fruit Quality Identification Using YOLO V2 Algorithm,” International Journal of Advanced Culture Technology, vol. 9, no. 1, pp. 190–195, 2021, doi: 10.17703/IJACT.2021.9.1.190.

[29] R. Raj, S. S. Nagaraj, S. Ritesh, T. A. Thushar, and V. M. Aparanji, “Fruit Classification Comparison Based on CNN and YOLO,” IOP Conf Ser Mater Sci Eng, vol. 1187, no. 1, p. 012031, Sep. 2021, doi: 10.1088/1757-899x/1187/1/012031.

[30] A. I. B. Parico and T. Ahamed, “Real time pear fruit detection and counting using yolov4 models and deep sort,” Sensors, vol. 21, no. 14, Jul. 2021, doi: 10.3390/s21144803.