



## Data Article

# A dataset of fortunella margarita images for object detection of deep learning based methods

Mei-Ling Huang\*, Yi-Shun Wu

Department of Industrial Engineering & Management, National Chin-Yi University of Technology, Taichung, Taiwan

## ARTICLE INFO

### Article history:

Received 19 May 2021

Revised 7 August 2021

Accepted 12 August 2021

Available online 18 August 2021

### Keywords:

Fortunella margarita

Image augmentation

Object detection

## ABSTRACT

Crops require appropriate planting techniques at different growth stages. Judgments on crop maturity affect the yield of crops. The planting and management of crops rely heavily on experienced farmers, which can reduce planting costs and increase yields. With the advancement of smart agriculture [1], images of crops can be used to accurately determine the growth stage of crops and estimate crop yields [2]. This can be combined with drones or smartphones to predict the growth stage and yield of *Fortunella margarita* for farmers in the future.

This article presents an *F. margarita* image dataset. We classified *F. margarita* into three growth stages: mature, immature, and growing. In this dataset, an image may contain plants in several growth stages. The images were divided into seven categories according to growth stage. The dataset contains a total of 1031 original images. The total number of images was increased to 6611 through data augmentation. In addition, the dataset includes 6611 annotations with 7 categories of manually marked positions of *F. margarita*. Field images were captured in Jiaoxi, Yilan County, Taiwan, using smartphones. The dataset can serve as a resource for researchers who use different algorithms of machine learning or deep learning for object detection, image segmentation, and multiclass classification.

\* Corresponding author.

E-mail address: [huangml@ncut.edu.tw](mailto:huangml@ncut.edu.tw) (M.-L. Huang).

Specifications Table

Subject	Agricultural Sciences, Computer Science
Specific subject area	Image processing, Image identification, Image classification, computer vision
Type of data	Images, Annotation files
How data were acquired	Field images were captured by iPhone 11 Pro; annotation was done by labellmg.
Data format	Raw
Parameters for data collection	The images were captured at multiple-angles in the outdoor fields by iPhone 11 Pro during sunny and cloudy days.
Description of data collection	Use a smart phone to capture photo images of fortunella margarita at different growth stages, and ask experts to visually evaluate and divide the fortunella margarita images into seven categories according to growth stages.
Data source location	Institution: National Chin-Yi University of Technology City: Taichung Country: Taiwan Latitude 24.1450556 and Longitude 120.73011
Data accessibility	Repository name: Mendeley Data; <a href="https://data.mendeley.com/datasets/wnv4bszcz/1">https://data.mendeley.com/datasets/wnv4bszcz/1</a> <a href="https://doi.org/10.17632/wnv4bszcz.1">https://doi.org/10.17632/wnv4bszcz.1</a> [3]

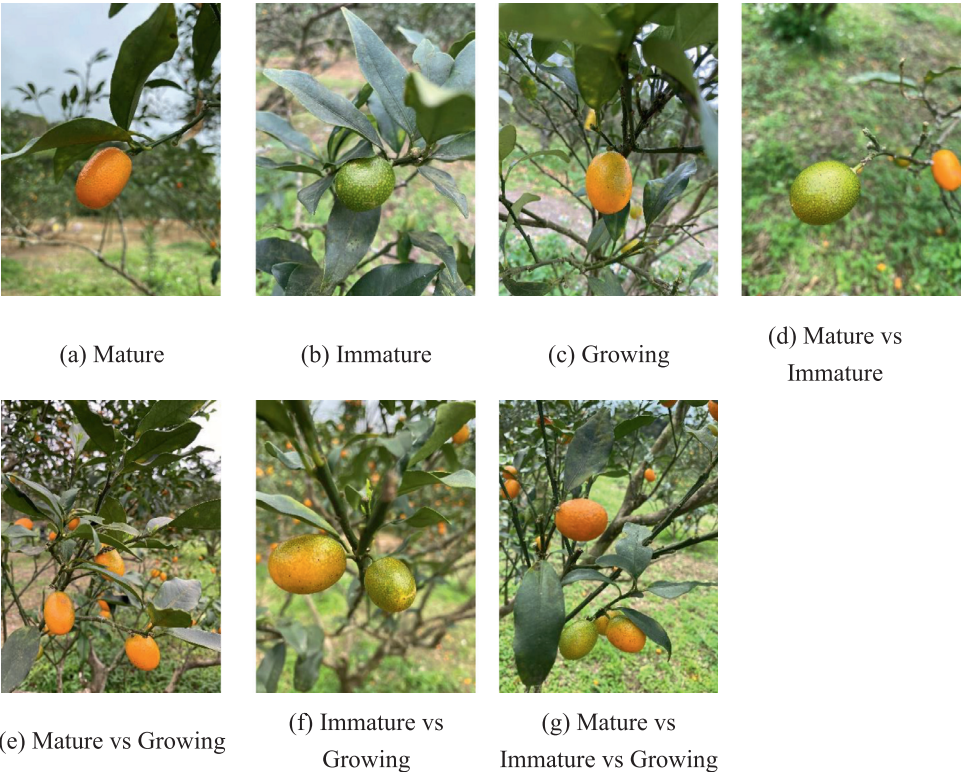
Value of the Data

- The dataset provided can be combined with drones or smartphones by farmers to predict the growth stage and yield of *Fortunella margarita*.
- Annotation images provided are ready for use by researchers to develop and compare the performance of new algorithms.
- The presented dataset can be used in the development and training of fruit detection systems with applications in segmentation and classification.
- This dataset is expected to be valuable for researchers working on object detection and multiclass classification.

1. Data Description

The images were captured at multiple angles on sunny and cloudy days in outdoor fields by using iPhone 11 Pro. The images were divided into seven categories according to the growth stages of *F. margarita*: (a) mature, (b) immature, (c) growing, (d) both mature and immature, (e) mature and growing, (f) immature and growing, and (g) all three stages set. Image annotations were performed using labellmg software [4]. The dataset uploaded to Mendeley is arranged in two folders: (1) growth stage classification images (growth stage classification) and (2) manual labeling and annotation files (labels). Each folder contains training, validation, and test subfolders.

- (1) Growth stage classification images: The number of original images was 1031. Fig. 1 shows examples of the original images for seven *F. margarita* categories. After data augmentation, a total of 6611 images were derived. The size of each image is 3024 × 4032 pixels, and the image format is JPG. Table 1 shows the number of training, validation, and test images for the seven categories before data augmentation.
- (2) Manual labeling and annotation files (labels): This dataset contains 6611 annotation images in XML format. Each file is manually labeled with the growth stage and location of the ob-



**Fig. 1.** Examples of fortunella margarita categories.

**Table 1**  
Number of training, verification and test images before data augmentation.

Category	Name	Training	Val	Test	Total
(a)	Mature	280	80	39	399
(b)	Immature	118	34	16	168
(c)	Growing	45	13	6	64
(d)	Mature vs Immature	49	13	8	70
(d)	Mature vs Growing	144	41	20	205
(f)	Immature vs Growing	22	6	3	31
(g)	Mature vs Immature vs Growing	66	19	9	94
Total		724	206	101	1031

ject. Fig. 2 shows an example of manual labeling and annotation. This file can be used by researchers to train deep learning models such as YoLo [5] and R-CNN [6].

- (3) The nomenclature used in the name of the images describes the category, image number in parenthesis, data augmentation method, and image format. For example, the file name “Growing (1).JPG” is the first image for category “Growing”; the file name “Growing (1).JPG\_brighter.jpg” is the first image for the category “Growing,” with augmentation executed by increasing the image brightness. The files containing the annotation information have the same name as the images but with the extension of the XML format.

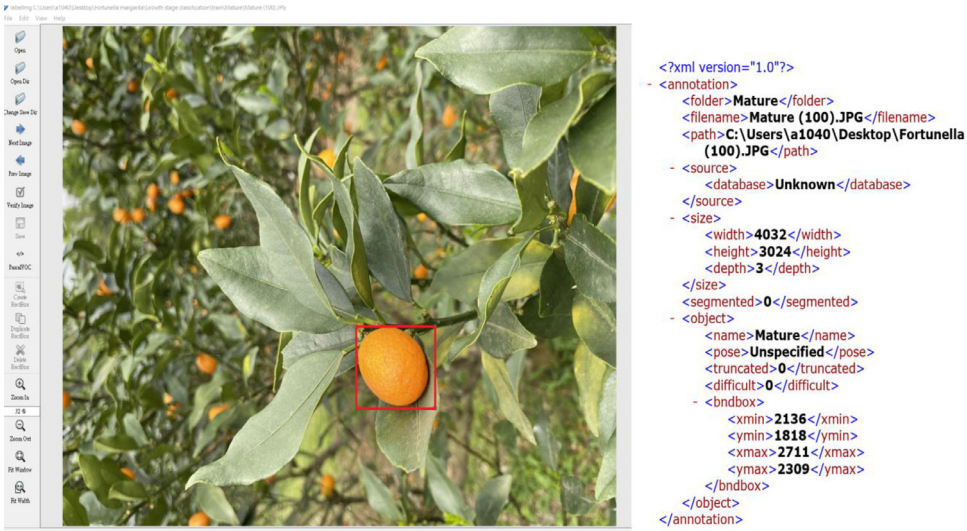


Fig. 2. A sample of annotation image.

2. Experimental Design, Materials and Methods

Data processing is divided into four steps: image acquisition, image preprocessing, image expansion and manual image labeling as follows.

2.1. Image acquisition

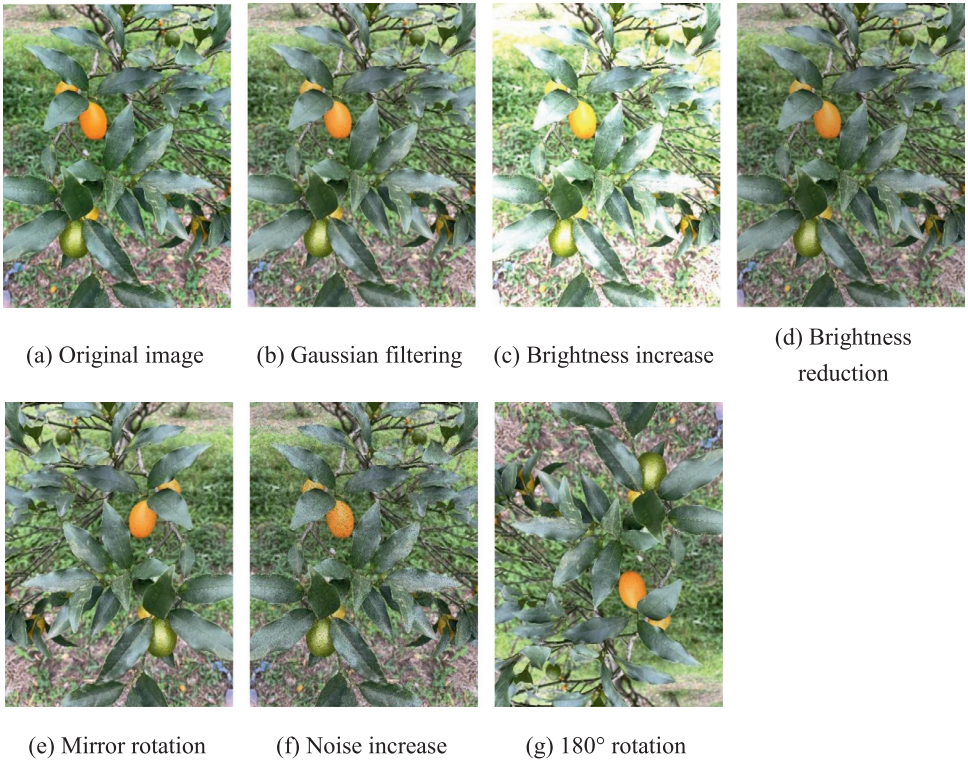
The images were captured using iPhone 11 Pro in Jiaoxi, Yilan County, Taiwan, under both clear and cloudy weather conditions; background changes were considered to capture multiangle photos 100–200 mm from the targets. The image file size is 3024 × 4032 pixels, and the format is JPG. We amassed a total of 1031 original images.

2.2. Image preprocessing

Experts evaluated and divided the *F. margarita* images into seven categories according to growth stages, and the number of images in each category is outlined as follows: (a) mature, 399; (b) young, 168; (c) growing, 64; (d) both mature and young, 70; (e) mature and growing, 205; (f) young and growing, 31; and (g) all three stages, 94. The images were divided into training, validation, and test subsets at a 70:20:10 ratio.

2.3. Image augmentation

We applied data augmentation methods [7], including Gaussian filtering, image brightness augmentation, image brightness reduction, mirror rotation, noise increase, and 180° rotation, to the images in the training and validation datasets. The total number of images acquired after data augmentation was 6611. Fig. 3 shows an example of the original image and the images obtained after data augmentation. Data augmentation increased the number of images. Table 2 presents the number of training, validation, and test images before and after data augmentation.



**Fig. 3.** Example of data augmentation.

**Table 2**

Number of images before and after data augmentation.

Category	Name	Before data augmentation			After data augmentation			Total
		Training	Val	Test	Training	Val	Test	
(a)	Mature	280	80	39	1960	560	39	2520
(b)	Immature	118	34	6	826	238	6	406
(c)	Growing	45	13	16	315	91	16	1064
(d)	Mature vs Immature	49	13	20	343	91	20	1295
(d)	Mature vs Growing	144	41	8	1008	287	8	434
(f)	Immature vs Growing	22	6	3	154	42	3	196
(g)	Mature vs Immature vs Growing	66	19	9	462	133	9	595
Total		724	206	101	5068	1442	101	6611

## 2.4. Manual image labeling

Each image must be labeled and classified before the training of the YOLO or R-CNN models. We used data labeling to manually label the targets and generate 6611 annotation files in XML format.



## Ethics Statement

This study did not conduct experiments involving humans and animals.

## CRedit Author Statement

**Mei-Ling Huang:** Conceptualization, Methodology, Writing – Original draft preparation, Investigation, Supervision, Writing – Reviewing and Editing, Funding acquisition; **Yi-Shun Wu:** Conceptualization, Methodology, Writing – Original draft preparation, Software, Datacuration.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Acknowledgments

The authors gratefully acknowledge the financial support of the Ministry of Science and Technology of Taiwan, R.O.C. through its grants MOST 109-2221-E-167-024-MY2.

## References

- [1] A. Kamilaris, F.X. Prenafeta-Boldú, Deep learning in agriculture: A survey, *Comput. Electron. Agric.* 147 (2018) 70–90 February, doi:[10.1016/j.compag.2018.02.016](https://doi.org/10.1016/j.compag.2018.02.016).
- [2] M. Rahnmooonfar, C. Sheppard, Deep count: Fruit counting based on deep simulated learning, *Sensors (Switzerland)* 17 (4) (2017) 1–12, doi:[10.3390/s17040905](https://doi.org/10.3390/s17040905).
- [3] Y.S. Wu, M.L. Huang, A dataset of fortunella margarita images, v1, Mendeley Data, 2021, doi:[10.17632/wnv4bszcz.1](https://doi.org/10.17632/wnv4bszcz.1).
- [4] Tzutalin D, labellmg, 2018. <https://github.com/tzutalin/labellmg>.
- [5] J. Redmon, A. Farhadi, YOLOv3: An incremental improvement, *arXiv (2018)*.
- [6] R. Girshick, Fast R-CNN, in *Proceedings of the IEEE International Conference on Computer Vision*, 2015, vol. 2015 Inter, pp. 1440–1448, doi:[10.1109/ICCV.2015.169](https://doi.org/10.1109/ICCV.2015.169).
- [7] C. Shorten, T.M. Khoshgoftaar, A survey on Image Data Augmentation for Deep Learning, *J. Big Data* 6 (1) (2019), doi:[10.1186/s40537-019-0197-0](https://doi.org/10.1186/s40537-019-0197-0).