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Data Article

Comprehensive guava fruit data set: Digital and thermal images for analysis and classification

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ABSTRACT

Guava (Psidium guajava) is a nutritious fruit known for its origin in Mexico, Central or South America, and the Caribbean. Its production faces declining levels, infections, and disease outbreaks. This dataset focuses on the early identification of guava diseases using image processing and computer vision. Farmers can detect and address diseases promptly by developing an expert system, increasing yields and reducing economic losses. The technology behind this dataset enables sustainable guava farming and disease prevention. This dataset consists of digital and thermal images of guava fruits, including healthy, damaged, and various diseased conditions such as wilt, Anthracnose, canker, and rot. The images are categorized based on the fruit's maturity level (mature, half-mature, and mature) and captured under different drop heights. The dataset also includes information on the damage-inducing methods, storage conditions, image capture schedule, and specific diseases present. The thermal images were acquired using hot air with controlled temperature and velocity.

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Specifications Table

Subject	Computer Science, Agriculture, and biological science
Specific subject area	Image processing, Image detection, Image classification, and computer vision [1]
Data format	Raw
Type of data	Image
Data collection	Digital images of guava fruits were captured using a Samsung M31S mobile camera with a resolution of 3000 × 3000 pixels. Thermal images were acquired using the FLIR One Pro, a thermal imaging device, ensuring controlled temperature and velocity parameters. Both cameras and fruit surfaces were positioned at a distance of 0.5 m. A chamber was formed to create a controlled environment by covering three sides of the rotating table with black rectangular cardboard. During image acquisition, hot air was supplied at a 45° angle to the fruit surface, allowing temperature gradients to be adjusted. The data collection involved systematically selecting representative guava fruits, considering conditions such as maturity levels, drop heights, and diseases. Selected fruits were visually inspected, and samples were chosen for imaging, following established protocols for accurate labeling and categorization. The collected dataset included digital and thermal images covering different fruit conditions. These images were normalized based on specific conditions, ensuring accurate analysis and classification of guava fruits.
Data source location	**Institution:** Velammal Engineering College (13°09′04.9″N 80°11′29.6″E) **City/Town/Region:** Chennai, Tamilnadu **Country:** India
Data accessibility	Repository name: Mendeley Data [2] Data identification number:10.17632/5kptnn7ycr.1 Direct URL to data: https://data.mendeley.com/datasets/5kptnn7ycr
Related research article	P. Pathmanaban, B.K. Gnanavel, S.S. Anandan, Guava fruit (Psidium guajava) damage and disease detection using deep convolutional neural networks and thermal imaging, Imaging Sci. J. 70 (2022) 102–116. https://doi.org/10.1080/13682199.2022.2163536.

1. Value of the Data

- These data provide a comprehensive collection of digital and thermal images of guava fruits, enabling researchers to study fruit analysis, disease detection, and quality assessment.
- Researchers in agriculture, specifically guava farming, can benefit from these data for improving production, disease prevention, and quality control measures.
- The data can be used to develop and evaluate algorithms, models, and systems for automated guava fruit inspection, disease detection, and decision-making systems.
- The dataset allows for comparative analysis between healthy, damaged, and diseased guava fruits, aiding in understanding disease progression and identifying early signs of infection.
- Researchers can explore image processing and computer vision techniques to develop non-invasive guava fruit analysis and classification methods using the provided images.
- The data can serve as a benchmark dataset for evaluating the performance of existing or newly developed algorithms for guava fruit disease detection and classification.

2. Data Description

Guava is very nutritious, one of the world's sweetest fruits, high in fiber, and a good source of essential vitamins and minerals [3]. The data set contains 600 healthy, 1100 damaged, and 395 different diseased (wilt, Anthracnose, canker, rot) guava fruit (mature, half-mature, and mature) digital images with a 3000 × 3000 resolution. Table 1 presents a detailed description of the digital image dataset. Additionally, 1222 raw thermal images have been added with a resolution of 1440 × 1080. Table 2 provides a detailed description of the thermal image dataset. The images are uploaded day-wise, maturity-wise, and drop height-wise. The data structure of the repository is shown in Fig. 1.

Table 1
Class wise digital image dataset distribution.

Day	Maturity	Drop height in cm/Category	Number of images
1	Half matured	15	23
		30	24
		45	27
		Healthy	23
	Immature	15	25
		30	27
		45	21
		Healthy	26
	matured	15	24
		30	19
		45	27
		Chilling injured/Healthy	32
2	Half matured	15	23
		30	0
		45	26
		Healthy	8
	Immature	15	27
		30	25
		45	22
		Healthy	26
	matured	15	23
		30	22
		45	25
		Healthy	10
3	Half matured	15	74
		30	
		45	
		Healthy	29
	Immature	15	25
		30	24
		45	24
		Healthy	27
	matured	15	22
		30	24
		45	25
		Healthy	5
4	Half matured	15	16
		30	15
		45	36
		Healthy	10
	Immature	15	24
		30	24
		45	24
		Healthy	30
	matured	15	22
		30	23
		45	27

(*continued on next page*)

Table 1 (*continued*)

Day	Maturity	Drop height in cm/Category	Number of images
5	Half matured	15	15
		30	15
		45	36
		Healthy	9
	Immature	15	26
		30	23
		45	21
		Healthy	13
	matured	15	22
		30	22
		45	28
6	Half matured	15	15
		30	15
		45	36
		Healthy	9
	Immature	15	26
		30	23
		45	21
		Healthy	13
	matured	15	22
		30	22
		45	28
7	Half matured	15	15
		30	15
		45	36
		Healthy	9
	Immature	15	26
		30	23
		45	21
		Healthy	13
	matured	15	22
		30	22
		45	28
	Diseased		395
	Total		**1541**

Table 2
Class wise thermal image dataset distribution.

Day	Maturity	Drop height in cm/Category	Number of images
1	Half matured	15	20
		30	24
		45	24
		Healthy	23
	Immature	15	26
		30	29
		45	24
		Healthy	23
	matured	15	24
		30	19
		45	28

(*continued on next page*)

Table 2 (*continued*)

Day	Maturity	Drop height in cm/Category	Number of images
2	Half matured	15	23
		30	
		45	25
	Immature	15	25
		30	25
		45	21
		Healthy	26
	matured	15	24
		30	20
		45	25
		healthy	10
3	Half matured	15	73
		30	
		45	
	Immature	15	22
		30	25
		45	24
		Healthy	27
	matured	15	16
		30	24
		45	27
		healthy	18
4	Half matured	15	16
		30	15
		45	37
	Immature	15	23
		30	27
		45	21
		Healthy	31
	matured	15	22
		30	23
		45	27
		healthy	10
5	Half matured	15	18
		30	12
		45	39
		healthy	14
	Immature	15	27
		30	29
		45	21
		Healthy	32
	matured	15	21
		30	23
		45	25
6	Half matured	15	18
		30	12
		45	40
		healthy	14
	Immature	15	27
		30	29
		45	21
		Healthy	32
	matured	15	21
		30	24
		45	25

(*continued on next page*)

Table 2 (*continued*)

Day	Maturity	Drop height in cm/Category	Number of images
7	Half matured	15	18
		30	12
		45	40
		healthy	14
	Immature	15	27
		30	29
		45	21
		Healthy	32
	matured	15	21
		30	24
		45	25
		Total	**1222**

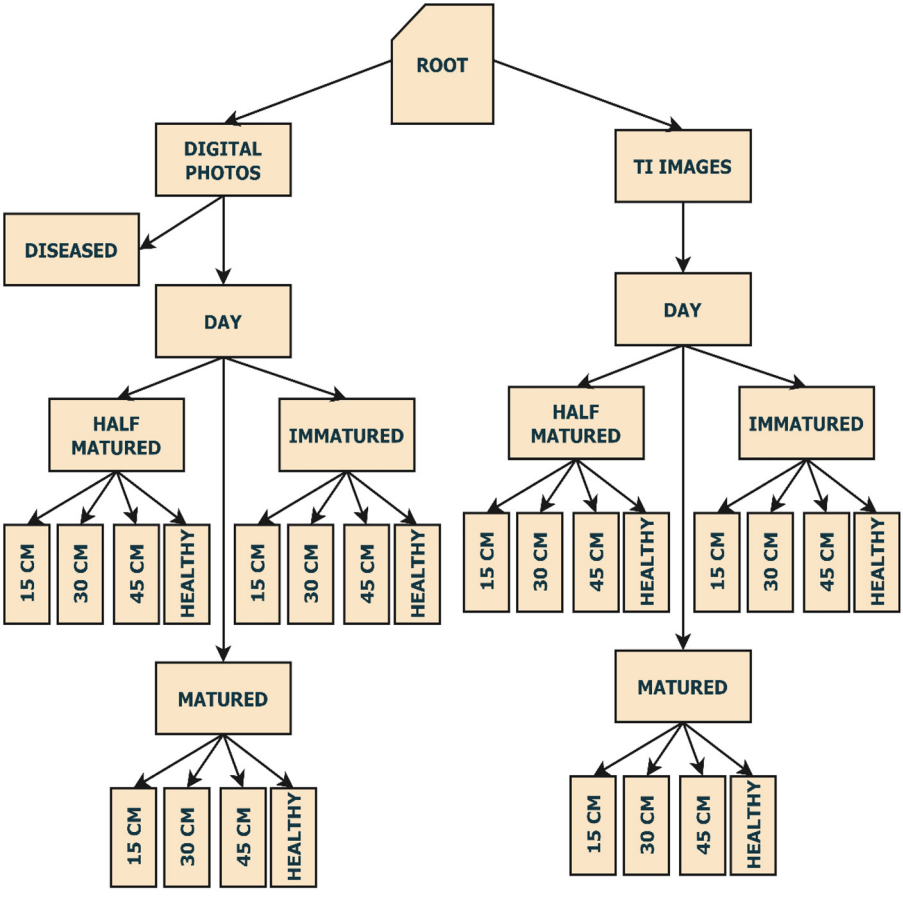

Fig. 1. The data structure of the repository.

3. Experimental Design, Materials and Methods

The experimental design systematically captured digital and thermal images of guava fruits under various conditions to create the dataset. The following methods and protocols were employed (Fig. 2):

Fig. 2. (a) Sample Healthy Fruits: These are photos of healthy guava fruits that showcase their different stages of maturity. The images illustrate the size, color, and texture transformations that occur as the fruits progress from their initial stages of maturity to being fully ripe. (b) Sample Diseased fruits: This figure showcases different examples of diseased guava fruits, illustrating specific conditions such as canker, rot, dehydration, and chilling injury. The images highlight the visual characteristics and symptoms associated with these fruit diseases, providing a reference for identification and analysis purposes. (c) Sample immature fruit with different drop height and different days of storage: This figure presents samples of immature guava fruits subjected to different drop heights and stored for varying durations. The image highlights the impact of drop height and storage time on the appearance and condition of the fruit, providing insights into the changes that occur during storage. (d) Thermal analysis using FLIR research tool: The figure showcases the process of thermal analysis using the FLIR research tool. The first image (from the left) represents the raw thermal image captured. The subsequent two images demonstrate how the FLIR tool can be utilized to capture and measure the temperature of the fruit.
Shows the different categories of fruits. (a) Sample images of healthy fruits with different maturity, (b) Sample different diseased fruits, (c) immature fruit with different drop heights and different days of storage, (d) Thermal analysis using FLIR research tool.

(c)

DAY	Healthy	0.15 m	0.30 m	0.45 m
1				
4				
7				

(d)

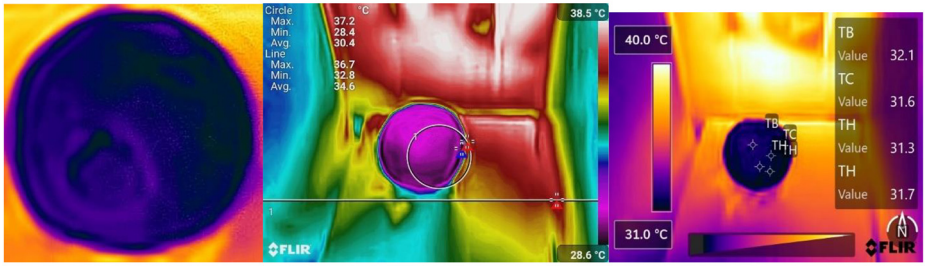

Fig. 2. Continued

3.1. Fruit selection

Representative guava fruits were selected for imaging, considering different maturity levels (mature, half-mature, and mature) and specific diseases (wilt, Anthracnose, canker, rot) [4].

3.2. Digital image acquisition

Samsung M31S mobile camera was used to capture digital images of guava fruits. The camera had a resolution of 3000 × 3000 pixels. The images were captured under controlled lighting conditions.

3.3. Thermal image acquisition

A thermal imaging device, FLIR one pro, acquired thermal images of guava fruits. The apparatus employed controlled temperature and velocity parameters. The ranges of the parameters determined using trialand error method.

3.4. Storage conditions

Before image capture, all guava fruits were stored in a refrigerated environment at 15 to 18°C and 65 to 70% humidity. This ensured standardized storage conditions for the fruits.

3.5. Drop heights and damage

The fruits were subjected to damage using a wooden weight. The specific weight used was 0.283 kg. The fruits were dropped from heights of 15 cm, 30 cm, and 45 cm to induce damage. The drop heights were carefully controlled during the experiments.

Image Labelling: Each captured image was labelled according to the specific conditions, including fruit maturity level, presence of diseases, and drop height [5].

3.6. Thermal image analysis method

The temperature of each fruit was determined using thermal images from the FLIR research tool. The damaged areas of the fruits were easily identifiable as they appeared brighter in the thermal images. The bruised center's temperature, the damaged area's boundary, and the remaining healthy regions were recorded. The actual temperature of the healthy regions was calculated by averaging ten random spots. Meanwhile, the bruised center and its boundary were determined by the average temperature of three random spot temperatures. The temperature difference was determined by subtracting the temperatures of the healthy regions from the bruised center and its surrounding boundary. Daily temperature measurements were taken from ten randomly selected samples from each maturity index and drop height [6,7].

4. Limitations

The quality of the thermal image depends on the hot air supply and surrounding temperature. For optimal image quality, it's essential to eliminate any water droplets that may have accumulated during image acquisition at room temperature, mainly when dealing with refrigerated fruits. Ensuring the correct marking of damaged areas is essential for easy identification. It may be challenging to capture the same fruit the next day if the markings are incorrect.

Ethics Statements

The authors have read and follow the ethical requirements for publication in Data in Brief and confirming that the current work does not involve human subjects, animal experiments, or any data collected from social media platforms.

Declaration of Competing Interests

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.

Data Availability

Guava (Psidium guajava) fruit digital and thermal Images (Original data) (Mendeley Data).

CRediT Author Statement

P. Pathmanaban: Conceptualization, Methodology, Software, Data curation, Writing – original draft; **B.K. Gnanavel:** Visualization, Investigation; **Shanmuga Sundaram Anandan:** Supervision, Software, Validation, Writing – review & editing.

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