RedGreen

AI-powered app for detecting watermelon ripeness and sugar level via image and sound analysis

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Capstone Project - Phase A

Introduction

The problem

Inaccurate Ripeness Selection

Traditional ripeness checks like tapping and observing the peel are unreliable, leading to wrong choices and waste.

No Easy Testing Tools

Scientific methods require expensive lab equipment, leaving consumers with no simple, accurate solution.

Wasted Time and Effort

Shoppers spend too much time guessing ripeness, leading to frustration and poor purchases.

Existing App Solutions

01 Melony

- Uses algorithms to analyze sound frequency when tapping a watermelon to determine ripeness.
- **Platform:** Android and iOS
- **Rating:** 2.4 out of 5 stars based on 9 ratings
- **Downloads:** Over 10,000 downloads

02 Watermelon Prober

- Analyzes sound from tapping the fruit to assess ripeness.
- **Platform:** Android
- **Rating:** 2.8 out of 5 stars based on 402 reviews
- **Downloads:** Over 100,000 downloads

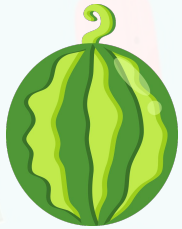
03 Melon Aid

- Uses AI to analyze vibration responses and sound frequency to detect ripeness.
- **Platform:** iOS
- **Rating:** 2.2 out of 5 stars based on 5 ratings
- **Downloads:** numbers are not provided

04 Clarifruit

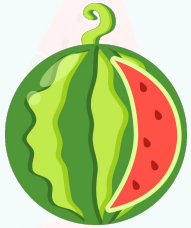
- Utilizes AI-powered vision to assess fruit quality, including ripeness and sweetness, from photos.
- **Platform:** Android and iOS
- **Rating:** 3.0 out of 5 stars based on 3 ratings
- **Downloads:** Over 5,000 downloads on Google Play

Our App Solution



User-Friendly UI

Clear guidance, noise prompts, and intuitive design.



Cloud-Based Processing

Faster, more precise than local models.

Dual-Modal Analysis

Combines image and sound for better accuracy.

Optimized AI Models

Fine-tuned for superior detection accuracy.

Research

Articles used

Watermelon Ripeness via Audio Analysis

This study uses Mel spectrograms and ECAPA-TDNN to analyze watermelon tapping sounds, achieving 89.5% accuracy, offering a portable, cost-effective alternative to lab methods

Fruit Ripeness Detection with YOLOv8

Using YOLOv8, this research classifies fruit ripeness based on peel features with 99.5% accuracy, leveraging fast, anchor-free AI for automated detection

Non-destructive Ripeness Judgement of Watermelon Based on Mel Spectrogram and ECAPA-DTNN
08 October 2024

Non-destructive Ripeness Judgement of Watermelon Based on Mel Spectrogram and ECAPA-DTNN

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Abstract—**In daily life, the majority of consumers generally have little professional knowledge to select ripe watermelons. However, the laboratory non-destructive methods for judging the ripeness of watermelon has limitations and is not suitable for consumers. Obviously, it is important and practical to develop a method for judging the ripeness of watermelon that is convenient for consumers. In this study, we utilized portable smartphones to record watermelon tapping audio signals of different ripeness levels and established a dataset. Then, we preprocessed the recorded audio signals. Next, we extracted Mel spectrogram features from the audio signals in the frequency domain using Short Time Fourier Transform and Mel Filter Bank. Finally, we**

fruit detection, as the internal structure and density of fruits change as they grow[4,5]. Therefore, acoustic detection technology can be regarded as the voiceprint of fruits.

Compared with near-infrared spectroscopy and nuclear magnetic resonance detection, acoustic detection technology has the advantages of simplicity, low cost, and easy accessibility. Therefore, in the scenario of consumers selecting watermelons, acoustic detection technology has broader application prospects and promotional value. However, most current research on acoustic detection technology[6-10] is still limited to laboratory environments and requires professionals

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Check for updates

Fruit ripeness identification using YOLOv8 model

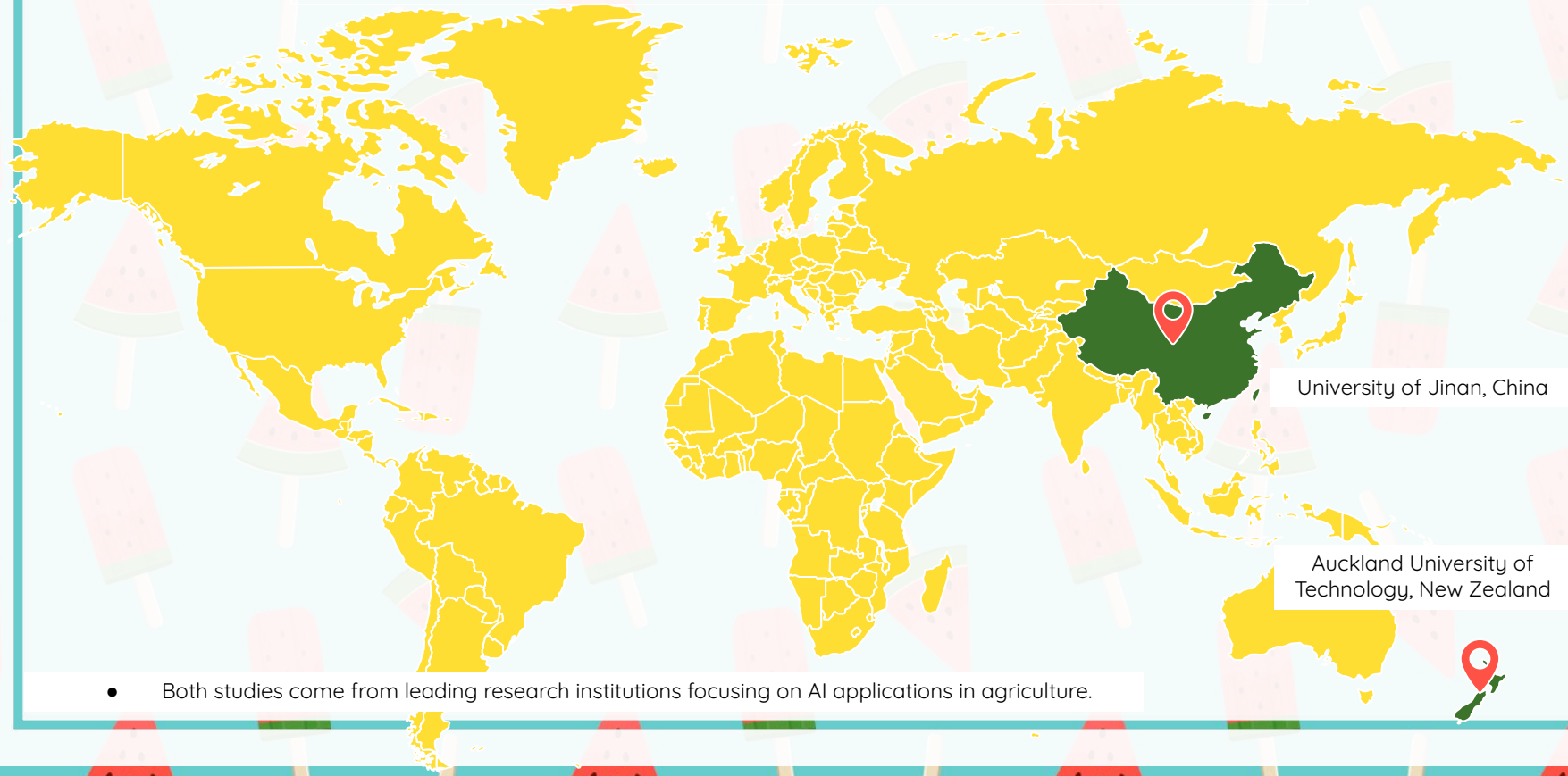
Bingjie Xiao[1] · Minh Nguyen[1] · Wei Qi Yan[1]

Received: 26 February 2023 / Revised: 11 June 2023 / Accepted: 18 August 2023 /
Published online: 31 August 2023

Abstract
Deep learning-based visual object detection is a fundamental aspect of computer vision. These models not only locate and classify multiple objects within an image, but they also identify bounding boxes. The focus of this paper's research work is to classify fruits as ripe or overripe using digital images. Our proposed model extracts visual features from fruit images and analyses fruit peel characteristics to predict the fruit's class. We utilize

Fruit ripeness identification using YOLOv8 model
18 August 2023

From where the articles?



- Both studies come from leading research institutions focusing on AI applications in agriculture.

Why this articles?

Well-Structured and Clear

These articles are well-organized, presenting clear methodologies, detailed experiments, and concise explanations, making them easy to understand and reference.

Reliable and Credible Sources

Both studies are peer-reviewed and published in reputable journals, ensuring scientific accuracy and trustworthy data for our research.

High-Performance Models

The studies utilize state-of-the-art AI models (ECAPA-TDNN & YOLOv8) with top accuracy (89.5% & 99.5%), proving their effectiveness in fruit ripeness detection.

Key models
&
DataSets

YOLOv8: The Future of Ripeness Detection

- **Unmatched Accuracy and Speed**

  With 99.5% accuracy and real-time processing, YOLOv8 outperforms older models using efficient, anchor-free detection.

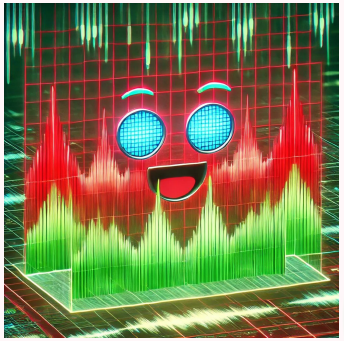
- **Optimized for Performance**

  Its C2f, Decoupled Head, Anchor-Free design, VFL, and DFL optimize speed, accuracy, and efficiency, making YOLOv8 ideal for real-time cloud and mobile applications.

- **Proven Through Rigorous Testing**

  Trained on diverse datasets, YOLOv8 handles occlusions, lighting variations, and complex fruit surfaces, ensuring consistent and precise results.

ECAPA-DTNN : Transforming Ripeness Detection Through Sound



- **Rich and Informative Features**

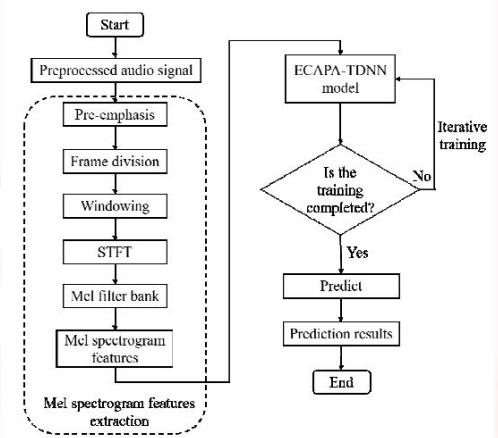
  Mel spectrograms capture detailed frequency patterns from tapping sounds, preserving key ripeness indicators that traditional audio analysis might miss.

- **Optimized for Deep Learning**

  By reducing spectral complexity while maintaining essential data, Mel spectrograms enhance machine learning performance, leading to higher classification accuracy.

- **Proven Accuracy in Ripeness Detection**

  Used with the ECAPA-TDNN model, Mel spectrogram analysis achieved 89.5% accuracy, proving its effectiveness in non-destructive watermelon ripeness testing.



Tapping Sounds

Recorded WAV files capture knock sounds, reflecting internal texture and ripeness.

Sweetness Data

A sugar meter measures sugar content, providing a numerical ripeness indicator.

Visual Features

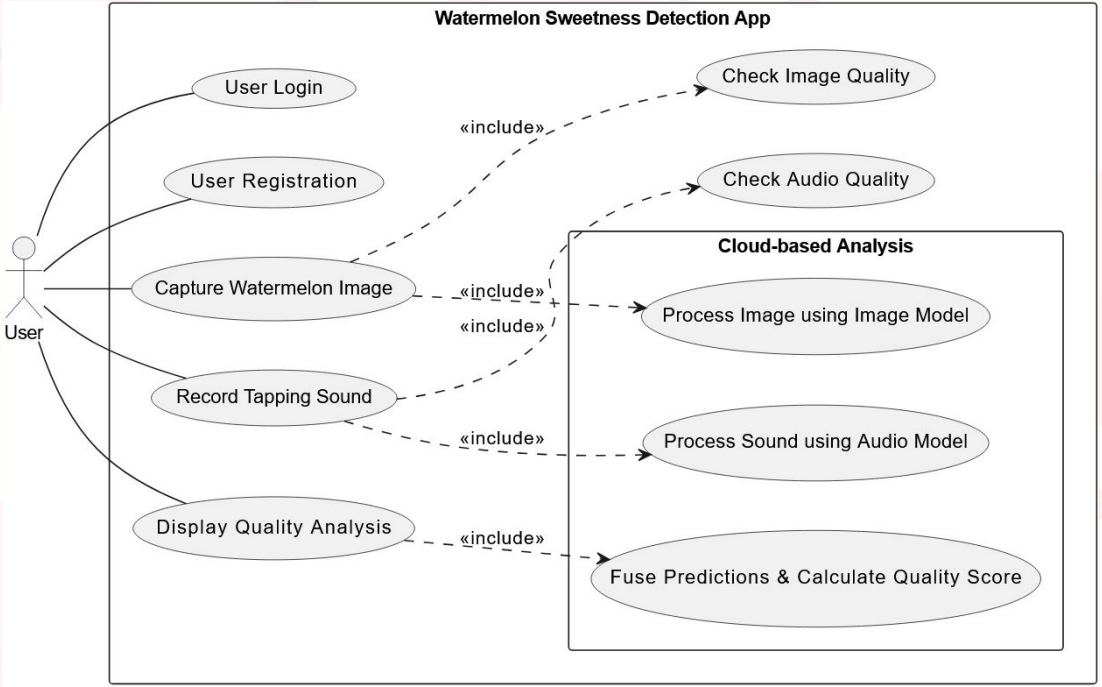
High-quality JPEG images document color, texture, and shape, aiding ripeness evaluation.

Integrated Data

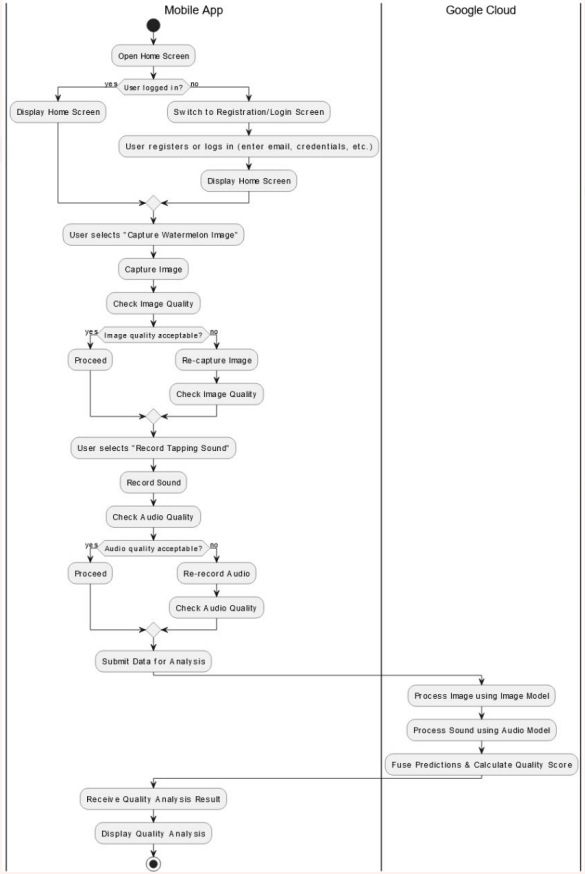
The dataset correlates sound, visuals, and sweetness for comprehensive ripeness analysis.

Diagrams

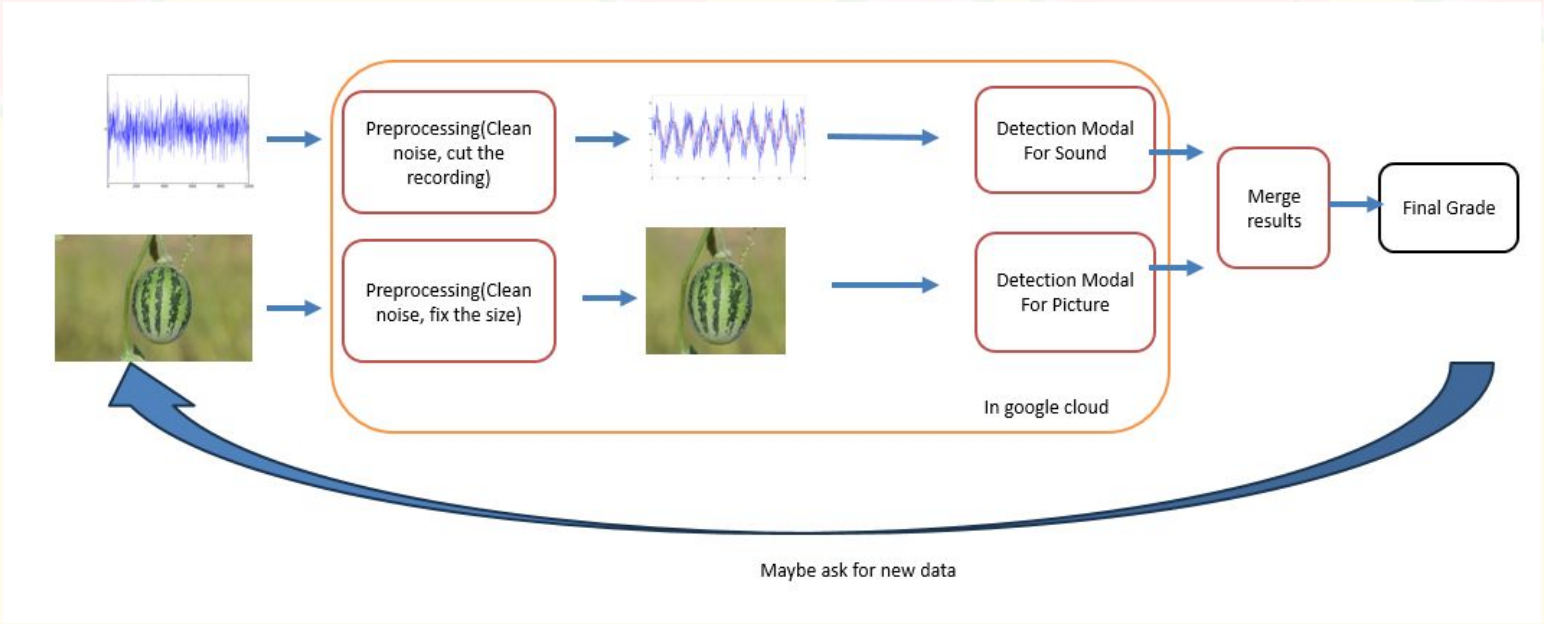
Use Case


Watermelon Sweetness Detection App
User Login
User Registration
Capture Watermelon Image
Record Tapping Sound
Display Quality Analysis
User
«include»
«include»
«include»
«include»
«include»
Check Image Quality
Check Audio Quality
Cloud-based Analysis
Process Image using Image Model
Process Sound using Audio Model
Fuse Predictions & Calculate Quality Score

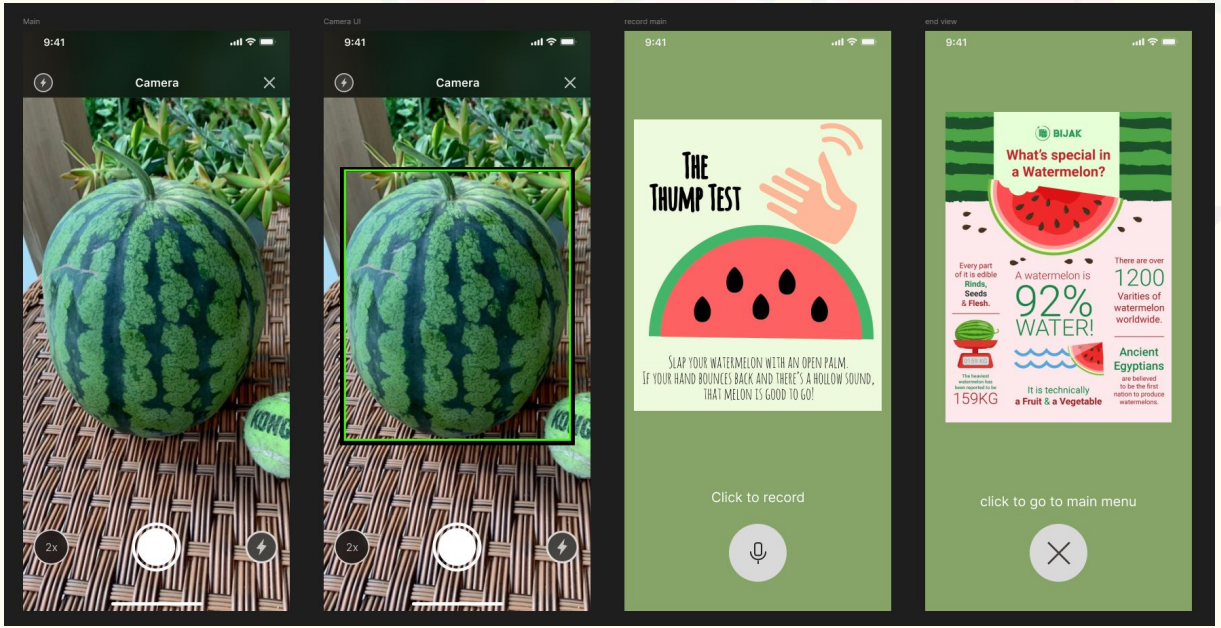
Activity Diagram



Back-end cloud Architecture



Front-end


Main
9:41
Camera
2x
Camera UI
9:41
Camera
2x
record main
9:41
THE THUMP TEST
SLAP YOUR WATERMELON WITH AN OPEN PALM. IF YOUR HAND BOUNCES BACK AND THERE'S A HOLLOW SOUND, THAT MELON IS GOOD TO GO!
Click to record
end view
9:41
BIJAK
What's special in a Watermelon?
Every part of it is edible Rinds, Seeds & Flesh.
A watermelon is 92% WATER!
There are over 1200 Varities of watermelon worldwide.
Ancient Egyptians are believed to be the first nation to produce watermelons.
159KG
It is technically a Fruit & a Vegetable
click to go to main menu

FR AND NFR

ID	Requirement	
1	The app should be user-friendly	NFR
2	The app should correctly classify watermelon quality at least 90% of the time.	FR
3	The app should work fast without significant delays	NFR
4	The app should ask from the user to tap again if it was recorded in loud environment	FR
5	The app should provide clear and easy to understand feedback	FR

Refrences

- Liu, J., Shi, H., Xia, Y., & Li, J. (2024). Non-destructive Ripeness Judgement of Watermelon Based on Mel Spectrogram and ECAPA-TDNN. ieeexplore.ieee.org
- Xiao, B., Nguyen, M., & Yan, W. Q. (2023). Fruit Ripeness Identification Using YOLOv8 Model. link.springer.com
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Thanks !