İstanbul Bilgi Üniversitesi 25 yıl

Smart Solutions for Waste Prevention with Case Study on Fruit and Vegetable

By Elena Battini Sönmez
Computer Engineering Dept.
Istanbul Bilgi University

About myself:

Assoc. Prof. Elena Battini Sönmez
Department of Computer Engineering
Istanbul Bilgi University, TR

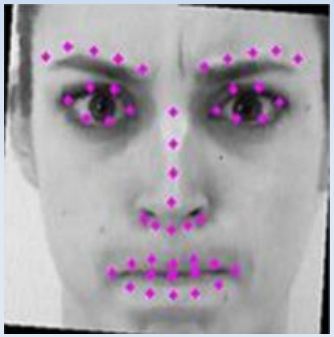
	Department	University	Year
Undergrad	Computer Science	Pisa University, Italy	1993
Master	Computer Science	Newcastle University, UK	1995
PhD	Computer Engineering	Yıldız Teknik University, TR	2012

About my research:

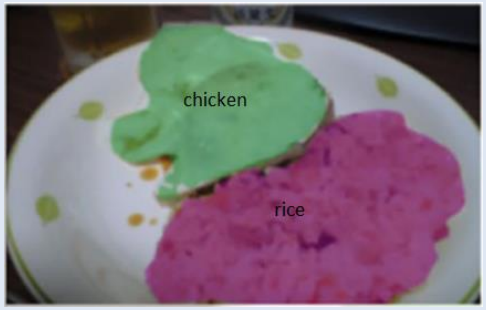
İstanbul Bilgi Üniversitesi 25 yıl

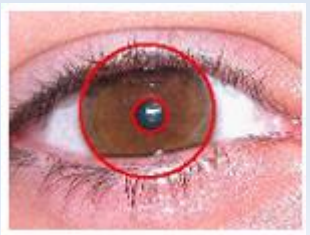
Digital Image Processing, Machine Learning, Human-Robot Interaction

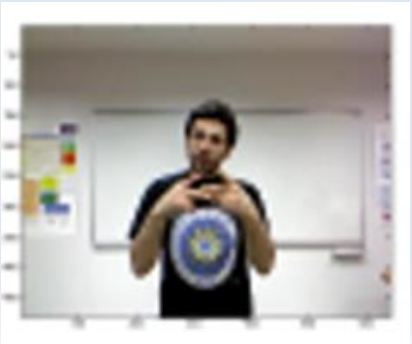
PhD topics: Expression Recognition using Sparse Representation-based Classifier (SRC)



- Food Segmentation and Classification
- Turkish Sign Language Recognition
- Age and Gender Recognition
- Fake image detection
- Traffic Sign Classification
- Iris Recognition
- Age and Gender Recognition
- …





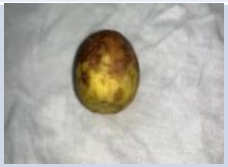


Sabbatical year:

- **CA22134:** 'Sustainable Network for **agro-food loss and waste prevention**, management, **quantification**, and valorisation (FoodWaStop)'
- Report of United Nation, which fixes **17 Sustainable Development Goals (SDG)** (https://sdgs.un.org/goals) to be reached by 2030:
  - Goal 2: 'Zero Hunger'
  - Goal 12: 'Ensure sustainable consumption and production patterns'. It includes **target 12.3, which aims to halve per capita global food waste at the retail and consumer levels, by 2030**
  - **Partnership**: Univ. Florence, Univ. Barcelona, ISTAÇ, IREN-ALIA, ?

Degree of Freshness of Fruit and Vegetables

Improved classification algorithms capable of recognizing the freshness level of Fruits and Vegetables (F&V) could be implemented in several automated systems, ranging from smart containers to intelligent fridges, that signal the level of freshness of F&V to the users.

	Tomatoe	Potatoe	Lemon
Fresh			
Medium			
Rotten			

Sample of the FruitVeg database (Fahad et al., Computers, Materials & Continua, 2022)

About the FruitVeg Database:

Benchmark paper: Fahad et al. 2022

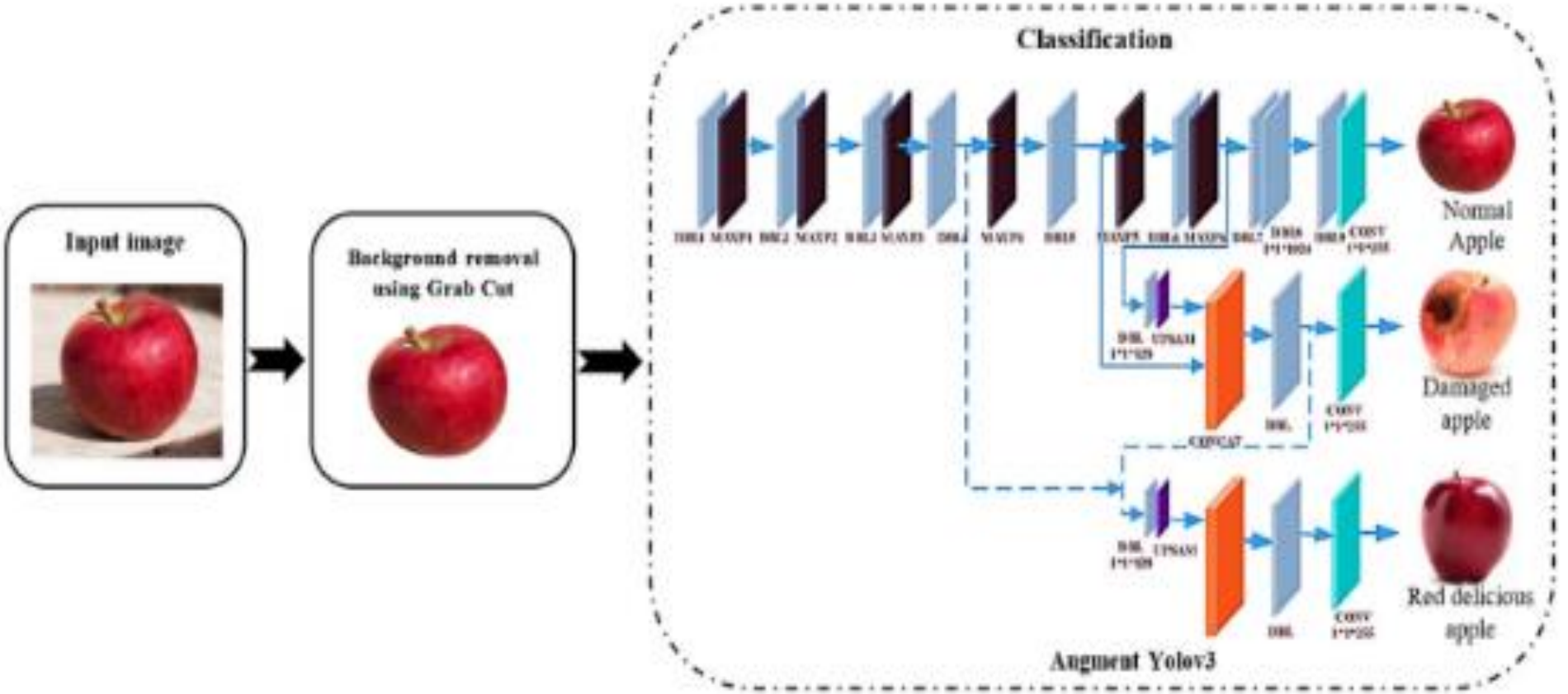
We achieved an accuracy of 94.58%, which beats Fahad et al. by approximately 12.58%.

Future work:

1. Testing and comparing the performances of alternative AI architectures, e.g. VGG16, YOLO, ..
2. Challenging a different, more difficult, database. Which one?
3. Building a new database.

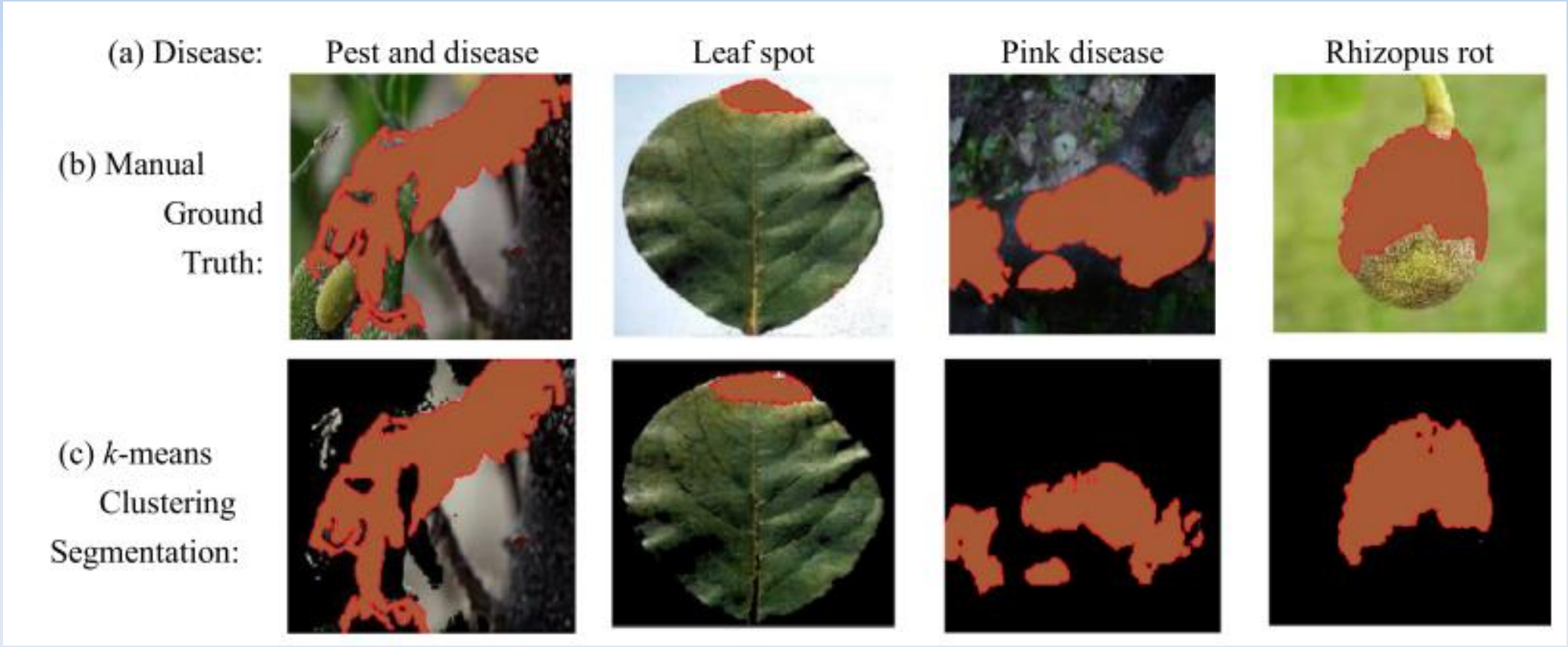
Name	Fresh	Medium	Rotten
Apple	4082	2975	2785
Banana	2530	899	1999
Orange	2335	1287	1988
Tomato	4261	4715	859
Guava	768	1696	773
Lemon	2281	2881	4033
Brinjal	999	1240	528
Chilies	1083	1392	805
Cucumber	775	857	682
Pepper	2478	927	980
Potato	2115	971	1080
Total	**23,707**	**19,840**	**16,512**

Alternative Research (1/4): Apple Fruit Quality Detection



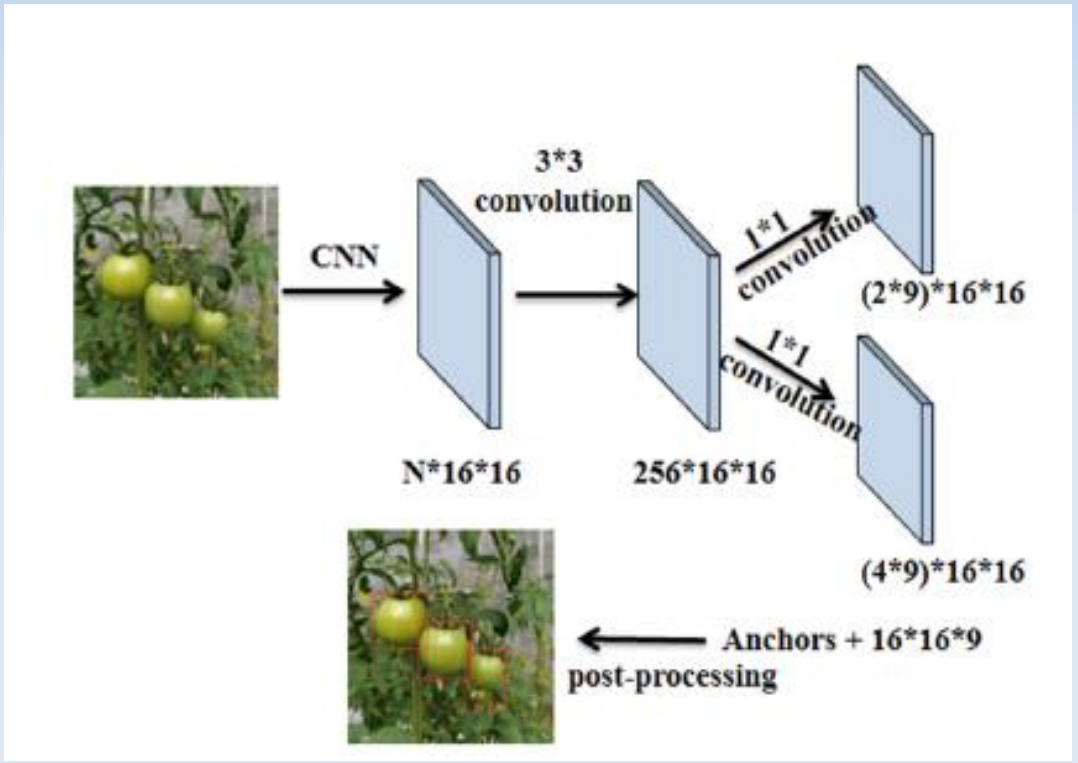
Karthikeyan et al., YOLOAPPLE, Signal Image and Video Processing, 2023.

Alternative Research (2/4): Agro-medical Expert System for Jackfruit Diseases



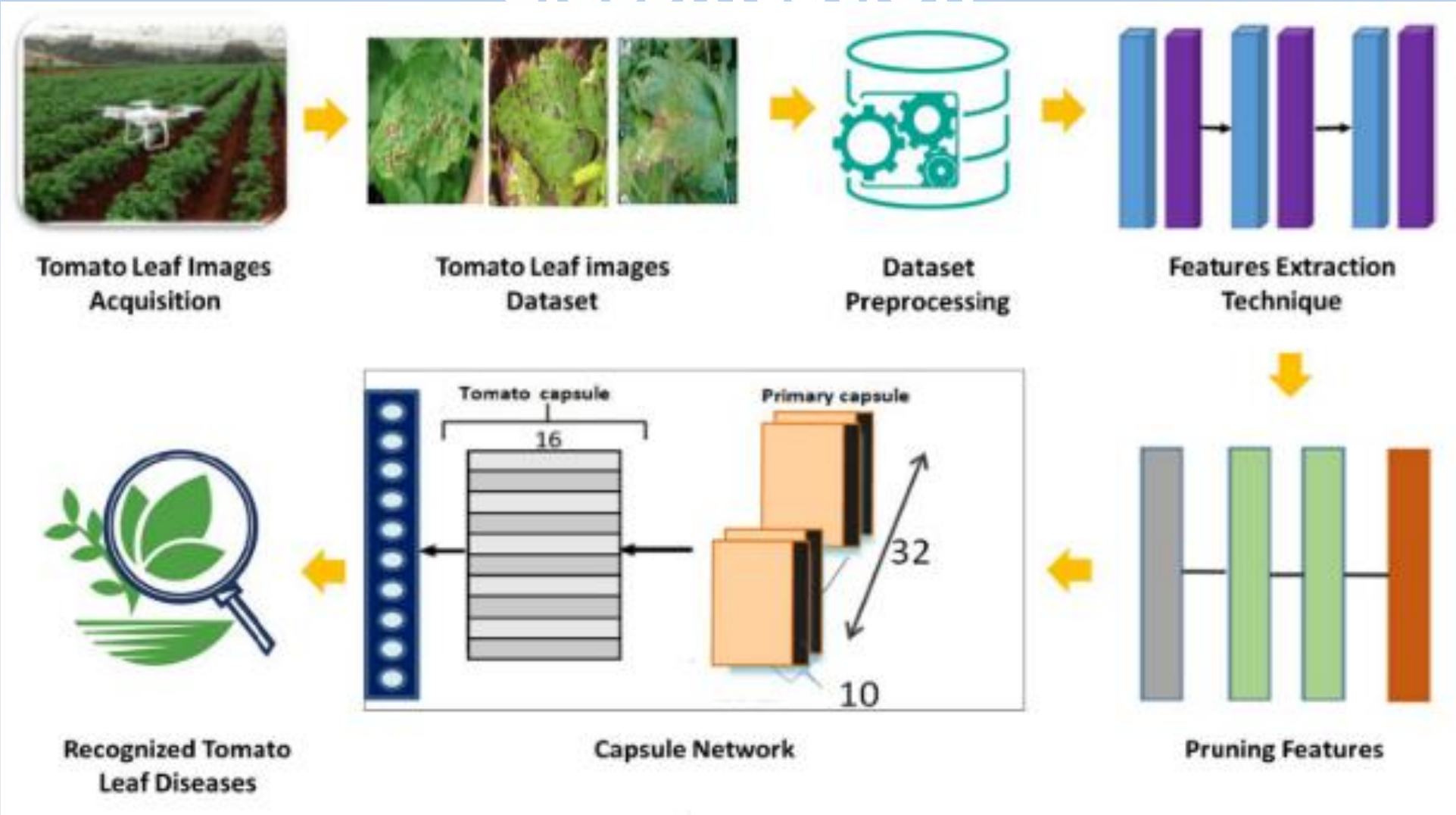
Habib et al. , Journal of King Saud University – Computer and Information Sciences, 2022.

Alternative Research (3/4): Detection and Segmentation of Mature Green Tomatoes



Zu et al., Sensors, 2021.

Alternative Research (4/4): AI for Tomatoes Leaf Disease Classification



Abouelmagd et al., Eurasip Journal of Image and Video Proc., 2024.

HOT Research Topic:

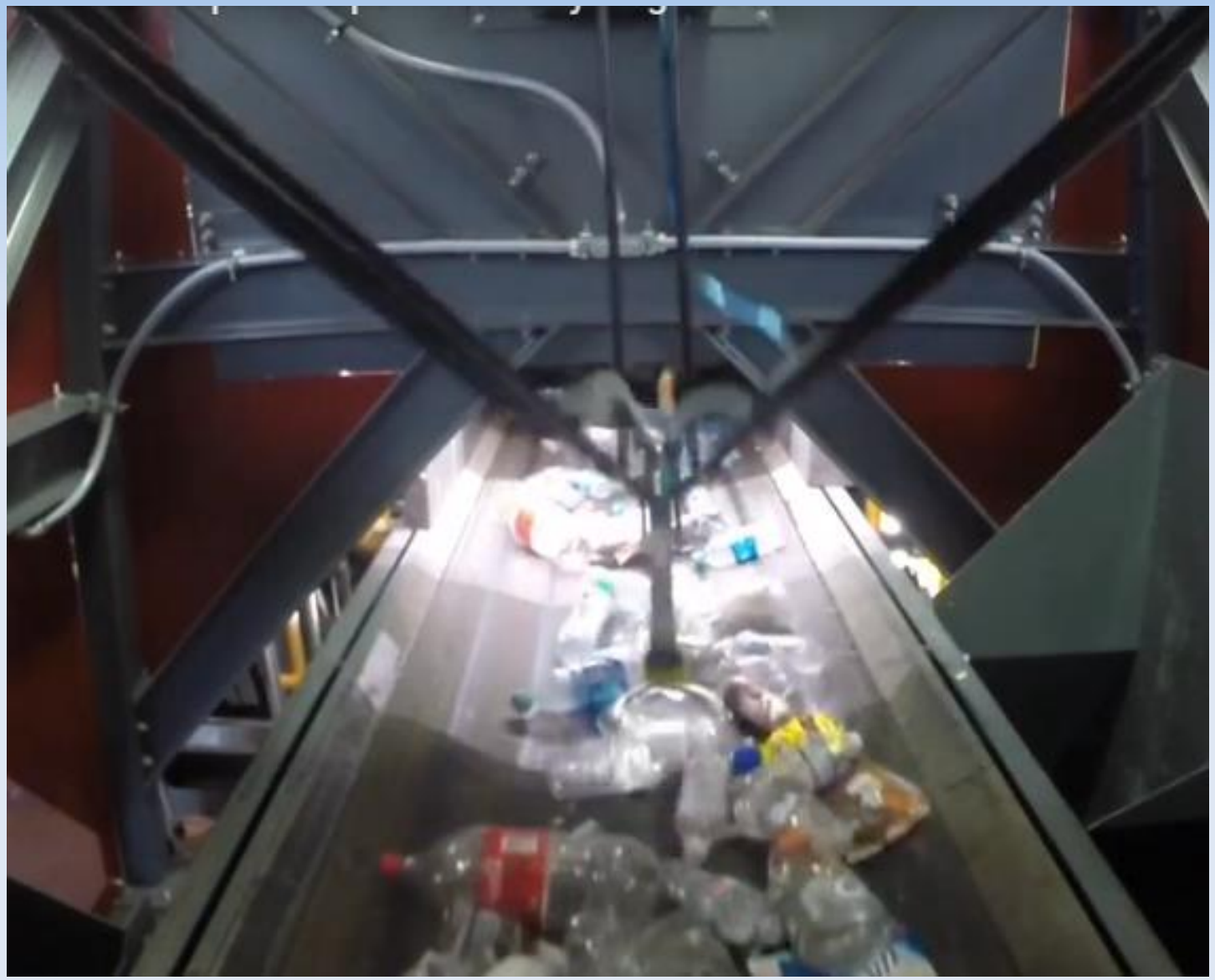
- Report of United Nation, which fixes **17 Sustainable Development Goals (SDG)** (https://sdgs.un.org/goals) to be reached by 2030:
  - Goal 12 includes **target 12.3**, which aims **to halve per capita global food waste at the retail and consumer levels**, by 2030.
- **Aim: To write an International (TR, IT, ES) Project on Food Waste**

  Partnership:
  - From TR: ISTAÇ: persuade people in Istanbul to separate (**food, non-food**) waste
  - from IT: IREN and/or ALIA, Prof. Stefano Berretti, Univ. Florence
  - From ES: Prof. Petia Radeva, Univ. Barcelona
  - You are welcome to this Project ☺

Automatic Separation of Non-Food Items (1/2):

Courtesy of Recycling Industry

Automatic Separation of Non-Food Items (2/2):



Courtesy of SADAKO Technologies

SDG 12.3: to halve food waste at consumer levels

Idea: To build intelligent rubbish bins

Since reduction starts by **acknowledging** it is necessary to improve existing **Artificial Intelligent (AI) algorithms capable of detecting, labelling and quantifying the amount of food thrown away** daily in every household.

Courtesy of Orbisk from Foodbytes

Improved AI algorithms for detecting and classifying food items

The initial study will use the **Segmented UEC Food-100** (Battini Sönmez et al., Multimedia Systems, 2023) database.

Left: Original image of the UEC Food-100 (Matsuda et al., 2012) database. Right: Corresponding picture of the Segmented UEC Food-100 database.

References

- Abouelmagd, L.M., Shams, M.Y., Marie, H.S. et al. “ An optimized capsule neural networks for tomato leaf disease classification “. J Image Video Proc. 2024, 2 (2024).
- Battini Sönmez, E., Memiş, S., Arslan, B. Batur, O.Z. “The segmented UEC Food-100 dataset with benchmark experiment on food detection”, Multimedia Systems 29, 2049–2057, 2023.
- Karthikeyan, M., Subashini, R., Srinivasan, C.,Santhanakrishnan, A. “ YOLOAPPLE: Augment Yolov3 deep learning algorithm for apple fruit quality detection “, Signal Image and Video Processing, 2023.
- Fahad, Labiba Gillani; Tahir, Syed Fahad; Rasheed, Usama; Saqib, Hafsa; Hassan, Mehdi; Alquhayz, Hani. “Fruits and Vegetables Freshness Categorization Using Deep Learning”, Computers, Materials & Continua . 2022, Vol. 71 Issue 3, 5083-5098.
- Matsuda, Y., Hoashi, H., Yanai, K. “Recognition of multiple-food images by detecting candidate regions”, IEEE International Conference on Multimedia and Expo, 25–30, 2012.
- Zu, L.; Zhao, Y.; Liu, J.; Su, F.; Zhang, Y.; Liu, P. Detection and Segmentation of Mature Green Tomatoes Based on Mask R-CNN with Automatic Image Acquisition Approach. Sensors 2021, 21, 7842.

Questions: