IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Advances in Tomato Classification Through Convolutional Neural Networks: A Comprehensive Literature Review

1.N.S.Kavitha,M.E.,Ph.D., Associate professor-Selection.Grade,Computer Science and Engineering.,Sri Ramakrishna Institute of Technology,Coimbatore

2.M.Aarathy Rhea,M.E.,Computer Science and Engineering.,Sri Ramakrishna Institute of Technology,Coimbatore

Abstract:

Tomato classification is paramount for quality assessment, sorting, and yield optimization in agriculture. This comprehensive literature review explores recent advancements in tomato classification leveraging Convolutional Neural Networks (CNNs). The review synthesizes insights from diverse studies, encompassing MRI-based classification, color feature analysis, machine vision systems, hyper spectral imaging, morphological characterization, nutrient deficiency detection, and disease classification. It examines methodologies, results, and implications, providing a holistic understanding of the field and delineating future research directions.

Introduction:

Tomato classification is critical for ensuring quality and market competitiveness, with various factors influencing classification

methodologies. This literature review aims to elucidate recent advancements in tomato classification, focusing on CNN-based approaches and their applications across different domains within agriculture.

Literature Survey :

1.MRI-Based Tomato Maturity Classification:

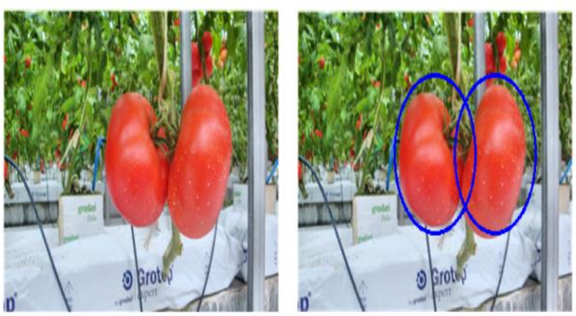
Zhang (2011) investigated MRI-based tomato maturity classification, utilizing MR images to capture changes in tomatoes at different maturity stages. The study employed Partial Least Square Discriminant Analysis (PLS-DA) to predict maturity, achieving high classification accuracies.

2.Automated Tomato Ripeness Evaluation:

El-Bendary (2014) proposed an automated approach for tomato ripeness evaluation using color features and machine learning algorithms. Their method, employing Principal Components Analysis (PCA) and Support Vector Machines (SVMs), demonstrated high ripeness classification accuracy.

3.Machine Vision-Based Tomato Detection:

Zhao (2016) developed a machine vision-based algorithm for automatic tomato detection in greenhouse environments. The approach combined Haar-like features and color analysis, achieving high detection accuracy and demonstrating potential for real-world applications.



(a) An original image (b) The result of SVM classifier

4.Hyper-Spectral Imaging for Disease Detection:

Xie (2017) utilized hyper spectral imaging to classify healthy and diseased tomato leaves. By employing K-nearest neighbor (KNN) and C5.0 models, the study demonstrated the potential of hyper spectral imaging for early disease detection.

5.Morphological Characterization of Tomato Varieties:

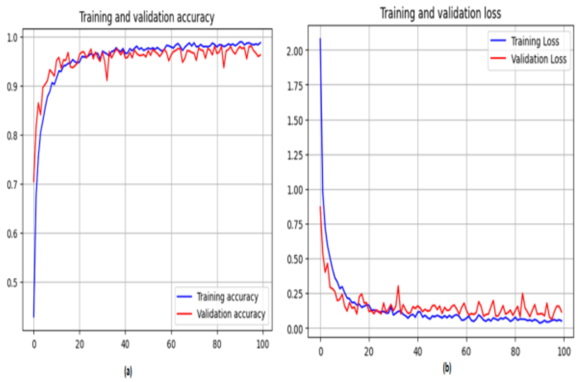
Salim (2018) characterized morphological traits of tomato inbred lines to enhance diversity and quality. The study highlighted diagnostic morphological traits for genotype differentiation, contributing to variety development efforts.

6.Nutrient Deficiency Detection in Tomato Plants:

Tran (2019) employed CNNs to detect and classify nutrient deficiencies in tomato plants based on image analysis. Their approach demonstrated high accuracy in predicting nutrient deficiencies, aiding in crop management practices.

7.Disease Classification Using CNNs:

Nazki (2020) proposed a CNN-based model for tomato disease classification, achieving high accuracy in identifying various diseases. Their approach utilized image processing and AI techniques to support early disease diagnosis and management.



8.CNN-Based Tomato Disease Diagnosis:

Trivedi (2021) developed a CNN-based model for early-stage tomato disease diagnosis. By preprocessing images and utilizing CNNs, the study achieved high accuracy in classifying nine different diseases, aiding farmers in timely disease management.

Conclusion:

The literature survey highlights the diverse methodologies and applications of CNNs in tomato classification across different domains within agriculture. From MRI-based maturity classification to disease diagnosis using machine learning algorithms, CNNs offer promising solutions for enhancing efficiency and productivity in tomato farming. Future research directions include exploring novel CNN architectures, integrating multi-modal data sources, and addressing real-world deployment challenges.

Merits:

1. Automation: CNN-based approaches enable automated tomato classification, reducing the need for manual intervention and increasing efficiency.
2. Accuracy: CNN models demonstrate high accuracy in classifying tomatoes based on various attributes such as maturity, ripeness, disease status, and nutrient deficiency.
3. Scalability: CNNs can handle large datasets and complex image processing tasks, making them suitable for applications in large-scale tomato production systems.
4. Timeliness: CNN-based systems provide rapid classification results, allowing for timely decision-making and intervention in agricultural practices.

Demerits:

1. Data Dependency: CNN models require large annotated datasets for training, which can be challenging to obtain and may introduce biases.
2. Computational Resources: Training CNN models requires significant computational resources, including high-performance GPUs, which may be cost-prohibitive for some users.

3. Interpretability: CNNs are often perceived as "black box" models, making it difficult to interpret the decision-making process and understand how features are being learned.

4. Deployment Challenges: Integrating CNN-based systems into real-world agricultural settings may pose challenges related to hardware compatibility, data transmission, and user interface design.

References:

[1] Lu Zhanga, Michael J. McCarthy. Measurement and evaluation of tomato maturity using magnetic resonance imaging. Volume 67, May 2012, Corpus ID: 98449514.

[2] Nashwa El-Bendary , Esraa El Hariri , Aboul Ella Hassanien , Amr Badr.Measurement and evaluation of tomato maturity using magnetic resonance imaging.Volume 42, Issue 4, March 2015.

[3] Yuanshen Zhao, Liang Gong, Bin Zhou, Yixiang Huang, Chengliang Liu.Detecting tomatoes in greenhouse scenes by combining AdaBoost classifier and colour analysis.Volume 148, August 2016.

[4] Chuanqi Xie , Ce Yang , Yong He. Hyperspectral imaging for classification of healthy and gray mold diseased tomato leaves with different infection severities .Volume19, Issue 35, 1 April 2017.

[5] M. Mahbubar Rahman Salim , M. Harunur Rashid , M. Mofazzal Hossain ,Mohammad Zakaria .Morphological characterization of tomato (Solanum lycopersicum L.) genotypes. Volume 19, Issue 3, April 2020.

[6] Trung-Tin Tran , Jae-Won Choi , Thien-Tu Huynh Le , and Jong-Wook Kim .A Comparative Study of Deep CNN in Forecasting and Classifying the Macronutrient Deficiencies on Development of Tomato Plant.Volume 9, Issue 8 (April-2 2019).

[7]Jaesu Lee , Haseeb Nazki , Jeonghyun Baek , Youngsin Hong and MeonghunLee. Artificial Intelligence Approach for Tomato Detection and Mass Estimation in Precision Agriculture. Volume 12, Issue 12 (June-2 2020).

[8]Naresh K. Trivedi , Vinay Gautam , Abhineet Anand , Hani Moaiteq Aljahdali, Santos Gracia Villar , Divya Anand , Nitin Goyal , Seifedine Kadry.Early Detection and Classification of Tomato Leaf Disease Using High-Performance Deep Neural Network.Volume 21, Issue 23 (December-1 2021).