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A SURVEY ON FRUIT DATABASE

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Abstract: This compilation of research papers delves into various facets of agricultural technology, offering innovative solutions to diverse challenges. The papers cover topics such as optimized fruit recognition through Evolution Strategy, a smart agriculture system for automatic fruit grading, and an Ensemble Machine Learning Model to identify healthy and rotten fruits, reducing global food waste. Methodological approaches using technologies like Convolutional Neural Networks and infrared technology are presented for tasks such as determining harvest time, disease detection, and quality assessment. The research also explores climate change's impact on fruit tree phenology and proposes an information architecture for the BC Tree Fruit industry to enhance Precision Agriculture adoption. Collectively, these papers contribute significantly to sustainable and efficient farming practices, addressing crucial issues in the agricultural sector.

Keywords: Automatic Food Grading, Ensemble Machine Learning Model, Infrared Technology, Quality Assesment, Image Saliency, Clima Tree Tool, Sustainable Farming Practices, Phenological Stages.

I. INTRODUCTION

A fruit database serves as a comprehensive and organized repository of information related tovarious types of fruits. In the context of agricultural research, food industry applications, and technological advancements, fruit databases play a crucial role in cataloging, storing, and retrieving data relevant to different fruit species.

These databases encompass a wide range of information, including the characteristics, properties, and images of fruits, making them valuable resources for researchers, farmers, and professionals in the agricultural and food sectors.

II. IMPORTANCE OF FRUIT DATABASE

Research and Development: Fruit databases are fundamental for researchers and scientists engaged in the study of fruit species. These databases provide a centralized platform for storingdata related to fruit varieties, nutritional content, growth patterns, and diseases, facilitating research aimed at improving crop yields, quality, and resistance to pests.

Educational Resources: Fruit databases serve as valuable educational resources for academicinstitutions, providing students with access to comprehensive information about various fruits.These databases may include images, botanical details, and scientific classifications, enhancinglearning experiences for students studying agriculture, biology, or related fields.

Food Industry Applications: In the food industry, fruit databases are utilized for product development, quality control, and market analysis. Information about the taste, texture, and nutritional content of different fruits assists in creating diverse and appealing food products.

Technological Advancements: With the rise of technology in agriculture, smart farming applications often integrate fruit databases to enhance precision agriculture. Image recognition,machine learning, and IoT devices can utilize fruit databases to identify and monitor fruit cropsfor tasks such as disease detection, ripeness assessment, and automated grading.

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III. LITERATURE REVIEW

Sl no.	Year of Publication	Project Title	Description
1	2023[1]	A Novel and Effective Ensemble Machine Learning Model for Identifying Healthy andRotten Fruits	Inefficiencies in handling food waste at every level of the food system, from farmsto homes to dining establishments, are endangering the world's food supply. Effective solutions are essential to address this problem, particularly when it comes todetermining the maturity and quality of fruits. In order to increase fruit storage life, this study focuses on applying deep learning algorithms to determine fruit freshness and quality. The research makesuse of datasets including images of banana fruits, which are enlarged by using image augmentation. Numerous smart agriculture application cases have demonstrated the potential of machine learning, particularly deep learning. In this study, we investigate howwell various deep learning systems classify fruit maturity. We suggest combining Support Vector Machines withEnsemble Machine Learning Technique (EMLT)[1].
2	2023[2]	Finding the appropriate harvest time of coffee fruits using convolutional neural networks	Fruit quality plays major role on coffee costs. When coffee fruits are grown in suitable nutritional, climatic, andhealth circumstances and at the right harvest period, high-quality coffee fruits are produced. The purpose of this research was to support farmers in their decision to harvest coffee fruits by presenting a methodological technique based on Convolutional Neural Networks (CNN) to identify the ripening process of coffee fruits. The study included photos of coffeeplants from farms in Brazilian towns that were further annotated by a number of specialists evaluating their maturity stage and whether or not to harvest. Afterwards,these pictures were utilised to train and assess the most recent CNN architectural models. The model exceeded 92% accuracy in the computer simulations, which produced satisfactory results[2].
3	2020[3]	Development of Fruit Grading System Based on Image Recognition	The workforce in agriculture has been greatly impacted by Taiwan's ageing population, which calls for creative solutions for sustainable farming methods. This study tackles this problem by utilising information and communication technology advancements to create a smart agricultural solution that is specific to Taiwan's small- and medium-sized farming models' requirements. In particular, the project focuses on applying image recognition technology to develop an automated fruit grading system. Three essential components make up the suggested system: a database, an identity host, and a transmission method. Fruits may be moved to the bottom of the camera more easily because to the transmission mechanism, which makes

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			grading easier. The OV9655 camera and additional peripherals are integrated by the identification host, which uses the STM32F746 core to precisely locate and categorize the fruits on the transport.[3]
4	2020[4]	BC Tree Fruit System-of-Systems Information Architecture (InitialDesign and Review)	Information Architecture for the BC (British columbia's) Tree Fruit System-of-Systems (First Design and Review)despite its benefits, growers may find Precision Agriculture (PA) technology to be overwhelming, complicated, and irritating. This study offers a high-level information architecture for the tree fruit business in British Columbia with the goalof assisting about 800 producers who manage orchards that yield substantial profits and boost the local economy. A high-level Information System (IS) prototype is part of the suggested concept, which aims to replace paper records and in-home database records with unified digital records. It also describes how to construct a reporting system that consistsof a Decision Support System (DSS) or a System-Of-Systems (SoS) with Business Intelligence systems (BIs) and a digital database with proper access controls for data ownership [4].
5	2019[5]	IoT based Automated Quality Assessment for Fruits and Vegetables using Infrared	This study presents a new Internet of Things (IoT) gadget that uses sensors like an infrared camera, an Arduino processor, and a wifi module to evaluate the quality of fruits and vegetables. Without having to harvest, the gadget allows for precise estimation of the ripening state of fruits and vegetables. During the growing season, monitoring takes place until the produce is attached to the plants. By ensuring that fruits and vegetables are gathered at the ideal ripeness and avoidingearly harvesting or rotting, this method seeks to reduce food waste. The gadget measures the fruit and vegetable heat index using infrared imaging. The heat index of ripening fruits and vegetables is then contrasted withthese heat indices [5].
6	2019[6]	Sweet citrus fruit detection in thermalimages using fuzzy image processing	Automation in the production chain has improved tremendously thanks to intelligent systems in agriculture. The goal of this work is to improve agricultural systems' efficiency by presenting a vision algorithm that is intended to estimate the number of fruits on sweet orange trees. The suggested computer vision systemmakes use of fuzzy image processing methods and infrared image capture. A thorough literature analysis examinesthe state-of-the-art in thermography applications in agricultural contexts as well as the state-of-the-art in fruit recognition systems. The developed approach makes use of the Hough transform for fruit recognition, fuzzy divergence for segmentation, and an intensification operator for contrast enhancement. The main objective is toautomate the normally done by hand process of counting the fruits on a tree [6].

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7	2017[7]	Fruit and vegetables classification system using image saliency and convolutional neural network	Classifying and identifying fruits and vegetables is a constant difficulty in manydaily production and life applications. Using picture saliency to detect object regions and a Convolutional Neural Network (CNN) model to extract featuresand conduct classification, this research presents an effective approach for classifying fruits and vegetables. The suggested method improves the accuracy of subsequent classification by using picture saliency to identify primary saliency regions based on a saliency map. A (Visual Geometry group)model is chosen to be trained on arecently created library of fruit and vegetable photos, which consists of 26 categories covering the main varieties found in real-world situations. Tests performed on this database show that the suggested system works well, with an amazing accuracy rate of 95.6% [7].
8	2015[8]	Fruit disease detectionusing color, texture analysis and ANN	As the need for the agricultural sector grows, it is critical to ensure fruit yield increases and efficient expansion. Farmers track fruits from harvest to growing period, however this method is typically imprecise and needs professional guidance for best outcomes. This research presents an effective smart farming method that reduces the need for human labour while increasing fruit growth and output. The suggested method uses image processing techniques to diagnose and categorise exterior problemsin fruits. The application makes use of the OpenCV library and segments images using the K- means clustering technique. Four feature vectors are used to categorise and map images to their corresponding illness categories: colour, morphology, texture, and fruit hole structure [8].
9	2014[9]	A Fruit Recognition Method via Image Conversion Optimizedthrough Evolution Strategy	With a focus on fruit recognition applications in mobile situations, this research suggests a novel way to improveitem recognition speed and accuracy. Conventional methods rely on fundamental characteristics like colour, shape, texture, and intensity, which mightcause constraints in terms of accuracy andperformance in mobile environments. The work presents a novel integrated approach that converts these fundamental propertiesinto corresponding code fields in order to overcome these issues. A feature database's effective search key is the resultant object code . Evolution Strategies are used to optimize the experiment's key parameters, whichresults in a notable 10% increase in accuracy. A fruit database with 1108 fruitphotos altogether and 36 different fruit classifications is used in the Experiment [9].

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10	2013[10]	Image processing for smart farming: Detectionof disease and fruit grading	Effective plant growth monitoring and disease identification are now essential for boosting crop output due to the agricultureindustry's rising demand. The fruit illnesses that affect plants are tracked using image processing in this work, fromplantation to harvest. Targeting three illnesses in grapes and two in apples, thestudy focuses on grape and apple crops. The suggested system makes use of the principles of artificial neural networks; more precisely, it adjusts weight during training by using the backpropagation method. Two picture databases are used: one for query images during the monitoring phase,and one for training with pre-stored disease photos. Three feature vectors— color, texture, and morphology—are used to classify images. [10]
11	2012[11]	Analysing global climatic change and its impact on fruit tree phenology using ClimaTree tool: Exampleof Anna apple tree under Tunisian conditions	The creation of the software programme "Climatree," which forecasts the phenological stages of tree fruits, is the main objective of this study. The early apple cultivar "Anna" is given particular attention. Estimating the completion datesof rest, flowering, and ripening under actual weather circumstances, evaluating the possible consequences of global warming on these phenological stages, andanalysing trends in chilling and heat buildup over the previous 20 years aresome of the goals. The study shows a linear rise in heat accumulation in the spring and a linear drop in chilling accumulation in the fall and winter, indicating recent climate warming in the Mediterranean region. Simulations are run using Climatree to forecast how climate change would affect the phenology of early apple cultivars [11].
12	2011 [12]	A System for Fruit Tree Canopy Characters Measuring Based on CAN-bus	Fruit tree canopy factors have to be measured in order to manage the orchard according to the site, including estimating fruit yield and applying fertilizer and pesticides at accurate rates to each tree. In order to quantify the impact of tractor deviation in the driving path between two rows of trees and uneven ground, a CAN (Controller are network) bus-based measuring system was developed. It integrated robot navigation technologies,are used. The node for this system was a C8051F040 micro controller. A detailed introduction to the hardware circuit was given, along with an analysis of the software and how the CAN transmission information frame was formed. Four ultrasonic sensors were used in an experiment with litchi trees in an orchard, and the results showed that the system was accurate and stable [12].

IV. CONCLUSION

The comprehensive exploration of diverse research papers in the field of agricultural technology, particularly focusing on fruit-related studies, reveals significant advancements and innovative solutions. The evolution of image recognition, machine learning, and IoT technologies has ushered in a new era for precision agriculture, smart farming, and efficient crop management. From fruit recognition methods optimized through Evolution Strategy toIoT-based automated quality assessment, each study contributes to the overarching goal of sustainable and technologically enhanced agriculture.

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