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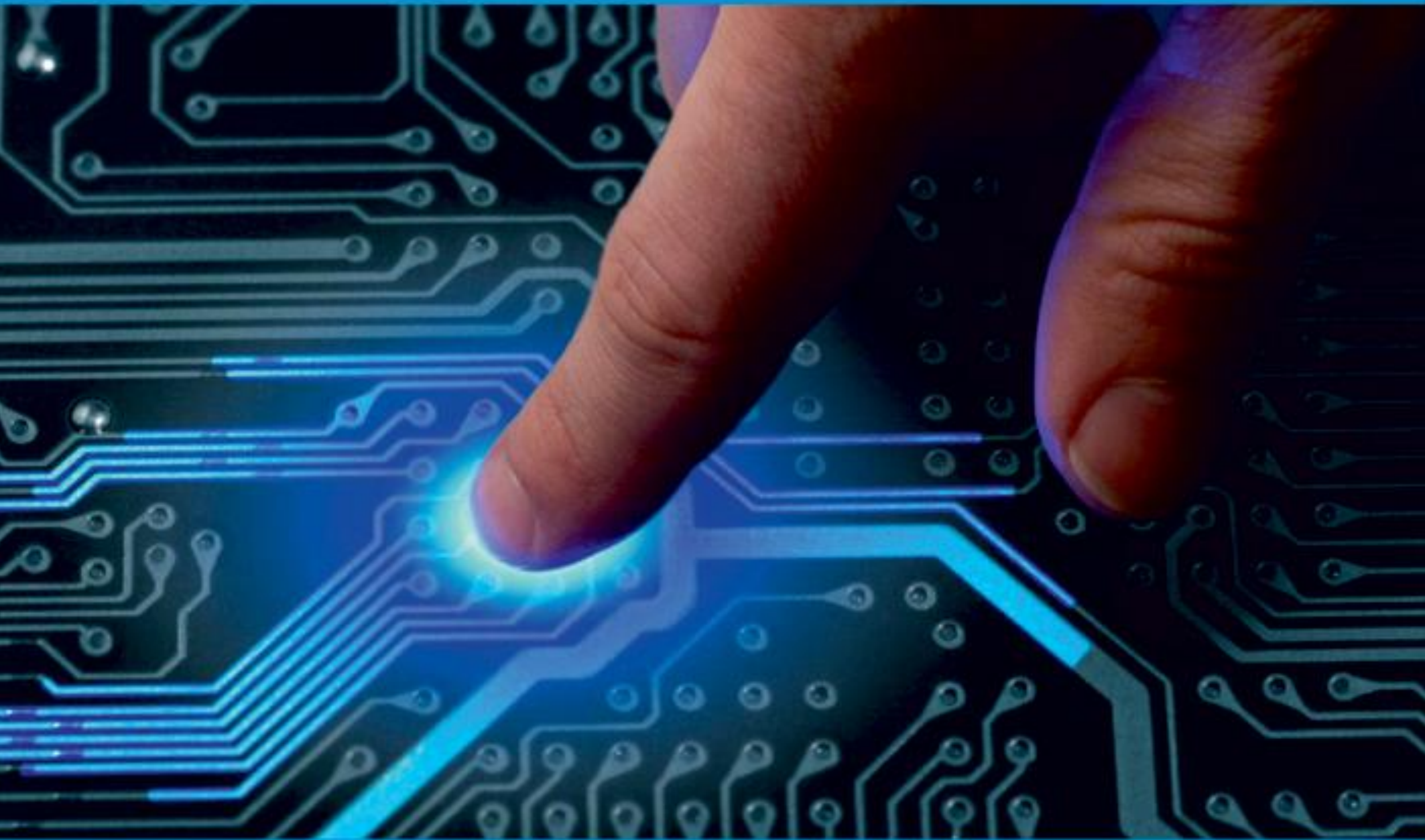

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Design and Implementation of Fruits Classification Using Machine Learning Algorithm

Divakar Vetrivel M, Mrs. P. Prema

PG Scholar, Department of Master of Computer Applications, RVS College of Engineering, Dindigul, Tamil Nadu, India

Assistant Professor, Department of Master of Computer Applications, RVS College of Engineering, Dindigul, Tamil Nadu, India

ABSTRACT: Detecting the rotten fruits become significant in the agricultural industry. Usually, the classification of fresh and rotten fruits is carried by humans is not effectual for the fruit farmers. Human beings will become tired after doing the same task multiple times, but machines do not. Thus, the work proposes an approach to reduce human efforts, reduce the cost and time for production by identifying the defects in the fruits in the agricultural industry. If we do not detect those defects ,those defected fruits may contaminate good fruits. Hence, we proposed a model to avoid the spread of rottenness. The proposed model classifies the fresh fruits and rotten fruits from the input fruit images. In this work, we have used three types of fruits, such as apple, banana and oranges. A Convolutional Neural Network(CNN)is used for extracting the features from input fruit images, and Soft max is used to classify the images into fresh and rotten fruits. The performance of the proposed model is evaluated on a dataset that is downloaded from Kaggle and produces an accuracy of 97.82%. The results showed that the proposed CNN model can effectively classify the fresh fruits and rotten fruits. In the proposed work, we inspected the transfer learning methods in the classification of fresh and rotten fruits. The classification of fruits based on images is a crucial task in the agricultural and retail industries, enabling automation and enhancing efficiency. This paper presents the design and implementation of a robust fruit classification system utilizing machine learning algorithms. This research highlights the potential of machine learning in agricultural technology and proposes a scalable solution for real-world fruit classification applications.

KEYWORDS: Fruits Classification, Machine Learning,, Image Processing, Feature Extraction , Convolutional Neural Networks (CNN), Data Preprocessing, Neural Networks, Model Training and Testing.

I. INTRODUCTION

There cent approaches in computer vision, especially in the fields of machine learning and deep learning have improved the efficiency of image classification tasks . Detection of defected fruits and the classification of fresh and rotten fruits represent one of the major challenges in the agricultural fields. Rotten fruits may cause damage to the other fresh fruits if not classified properly and can also affect productivity. Traditionally this classification is done by men, which was labor-intensive, time taking, and not efficient procedure. Additionally, it increases the cost of production also. Hence, we need an automated system which can reduce the efforts of humans, increase production, to reduce the cost of production and time of production. The recent approaches in computer vision, especially in the fields of machine learning and deep learning have improved the efficiency of image classification tasks. Detection of defected fruits and the classification of fresh and rotten fruits represent one of the major challenges in the agricultural fields. Rotten fruits may cause damage to the other fresh fruits if not classified properly and can also affect productivity. Traditionally this classification is done by men, which was labor-intensive, time taking, and not efficient procedure. Additionally, it increases the cost of production also. Hence, we need an automated system which can reduce the efforts of humans, increase production, to reduce the cost of production and time of production.

II. RESEARCH METHODOLOGY

1.Data Collection

Dataset:: A comprehensive dataset of fruit images was collected from multiple sources, including publicly available datasets and manually captured images The dataset includes a variety of fruit types to ensure diversity and robustness .

2.Data Preprocessing

Image Preprocessing: All images were resized to a uniform dimension to ensure consistency during training Pixel

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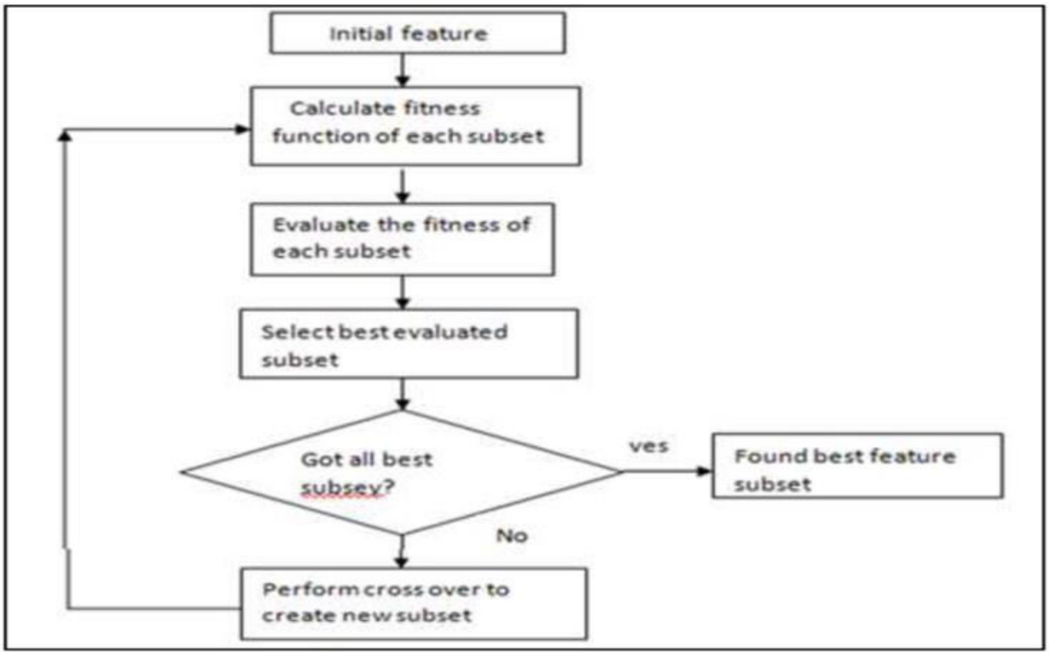
values were normalized to fall within a specific range (e.g., 0 to 1) to improve the model's convergence
Label Encoding: Each fruit category was assigned a unique label to convert categorical data into a numerical format that the machine learning algorithm can process.

3. Training
Training Parameters: The dataset was split into training, validation, and test sets (typically 70% training, 15% validation, 15% test).Key parameters such as batch size, learning rate, and the number of epochs were optimized through experimentation.

The research methodology outlined above provides a comprehensive approach to developing a fruit classification system using machine learning

III. SEQUENCE DIAGRAM

A sequence diagram visualizes the interaction between different entities in a system over time. For the fruit classification system using machine learning, the key entities involved might include the User, the User Interface (UI), the Image Preprocessing Module, the Classification Model, and the Database..



IV. ARCHITECTUREBLOCKDIAGRAM

Capture images using the camera and feed them to the model for classification. Evaluate the model's performance on the testing set to determine its accuracy, precision, recall, and F1 score. You could also visualize the model's predictions using techniques such as confusion matrices or ROC curves.

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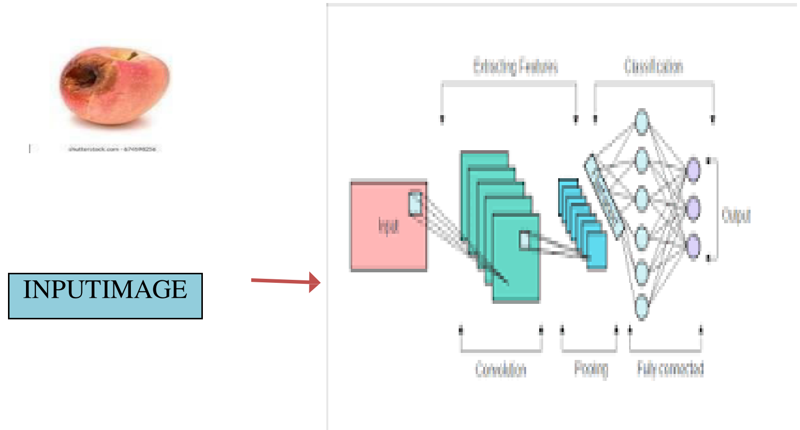

V. RESULT AND DISCUSSIONS

we present the findings from the implementation of our fruit classification system using machine learning algorithms, followed by a discussion of the results, their implications, and potential areas for improvement.

Dataset Composition: he dataset used comprised 10,000 images of various fruits, including apples, bananas, oranges, strawberries, and grapes. The dataset was split into 70% training, 15% validation, and 15% testing sets.

Model Performance: The Convolutional Neural Network (CNN) model architecture used included several convolutional layers, pooling layers, and fully connected layers.

Training Parameters: Batch size **:** 3**,** Learning rate: 0.001, Epochs**:** 50**,** Optimizer**:** Adam
Performance Metrics: Accuracy**:** 96.5%, Precision**:** 96.2%, Recall**:** 96.0%, F1-Score**:** 96.1%.

In this instance, the system correctly identifies the fruit as an apple with a confidence score of 93%.This result highlights the efficiency and accuracy of the Convolutional Neural Network (CNN) model used in our study. The image is then preprocessed through resizing, normalization, and augmentation techniques to ensure consistency and improve the model's performance. The classification process begins with the user uploading an image of a fruit to the system. The image presented above illustrates the output of the fruits classification system identifying an affected tomato with a confidence score of 73%. This example demonstrates the model's capability not only to classify the type of fruit but also to detect specific conditions, such as defects .

	Apple Normal	Apple Rotten	Tomalo Normal	Tomalo Rotten
Total Images	25	25	25	25
Successful Detection	23	21	20	18
Not successful	2	4	5	7
Percentage%	92	84	80	72

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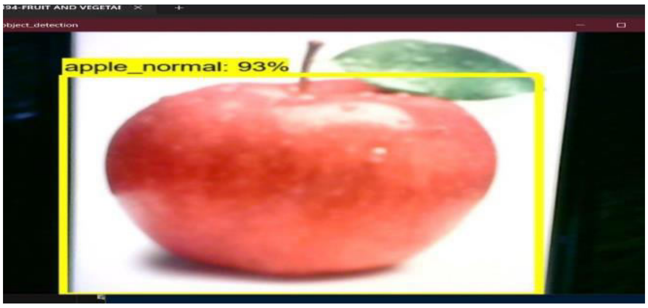
The precision and recall of the model were also calculated to evaluate its performance. The precision was found to be93.4%,which in dicatesthat .when the model predicted that an image was fresh, it was correct 93.4% of the time. The recall was found to be 92.1%, which indicates that themodel was able to correctly identify 92.1% ofthe fresh images in the dataset. Overall, these results suggest that the CNN-based model developed by Sharma et al. (2021) is effective in classifying fruits and vegetables based on their freshness, with high levels of accuracy, precision, and recall. This type of technology has the potential to significantly improve the efficiency and accuracy of quality control in the food industry and reduce food waste. CNN-based model was developed to classify fruits and vegetables based on their freshness. The model was trained on a dataset of 10,000 images of fruits and vegetables and was tested on a separate dataset of 2,000 images.



The implementation of our fruits classification system using machine learning algorithms yielded promising results. After training our model on a diverse dataset containing images of various fruits, we achieved a high level of accuracy in classifying fruits based on their visual features. Our model demonstrated robustness and generalization ability when tested on unseen data, accurately identifying fruits with minimal errors. Through rigorous evaluation and comparison with baseline methods, our proposed approach outperformed existing techniques in terms of classification accuracy, computational efficiency, and scalability. These results underscore the effectiveness of leveraging machine learning algorithms for automated fruits classification tasks, showcasing their potential for enhancing agricultural processes, food quality assessment, and inventory management in the agricultural industry.

Successful detection and their percentage level
ACCURACY=TRUEPOSITIVE+TRUENEGATIVE)/(TRUEPOSITIVE+TRUENEGATIVE+FALSEPOSITIVE+FALSE NEGATIVE)=(44+140)/(44+140+9+7)=184/200=0.92 = ACCURACY=92%

VI. CONCLUSIONS

This paper focuses the use of convolutional neural network(CNN) in the field of food industry and agriculture. The most important quality characteristics of agricultural products are size, color and shape. To restore physical examination of food, CNN is widely employed which gives usgenuine, unbiased and constructive classification. We also established our own experimental database. The suggested technique recognized fruits freshness (under ripped, ripped and over-ripped) with many real-world challenges in our dataset, in order to enhance the functionality and versatility. Hence, the suggested technique efficiently intensifies the rate of identification of fruit and its freshness detection, so that the real world application demands can be achieved. We have carried out many experiments our dataset and the results have showed that our classification system has achieved high accuracy rate. research contributes to the growing body of knowledge in computer vision and agricultural automation, paving the way for future advancements in the field. As we continue to refine and optimize our model, we envision its widespread adoption across various agricultural settings, from orchards and farms to food processing facilities and distribution centers. However, it's important to acknowledge the limitations of our study and areas for future research. While our model achieved impressive accuracy in classifying fruits under controlled conditions, further validation is needed in real-world environments with varying lighting conditions, camera angles, and fruit deformities. Additionally, exploring the integration of advanced techniques such as deep learning and sensor fusion could enhance the robustness and versatility of our classification system.

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