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A modern approach to track food shelf life using CNN and NLP

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Abstract : Our project aims to solve the problem of food wastage that has become a major concern in recent years. With the growing population and limited resources, it's important to reduce food wastage. We have developed an application that helps people keep track of their food items and their expiry dates. The application uses image processing to identify the food item and estimate its ripening stage and expiry date. We have implemented AI and deep learning techniques like CNNs to detect the type of fruit and check for any defects in it. The application sends reminders to the user to consume the food item before it goes stale. This not only helps reduce food wastage but also saves money for the user. Our project has the potential to make a significant impact in the fight against food wastage. With the increasing use of smartphones, our application can be easily accessible to a large number of people. By reducing food wastage, we can make a significant contribution to the environment and to society. The implementation of our project can potentially change the way we consume food and reduce the negative impact on the environment. The use of technology to solve social and environmental problems is a growing trend, and our project is a small contribution to this movement. The development of this application required extensive research and implementation of various algorithms, making it a challenging and rewarding experience. Overall, we hope our project inspires more innovative solutions to tackle the problem of food wastage and contribute to a more sustainable future.

IndexTerm:AI,CNN,Food Wastage

I.INTRODUCTION

Food wastage is a global issue that affects food security, economic productivity, and environmental sustainability. India, despite producing abundant food, is a major contributor to this issue, with an average household waste of 50 kg of food per person per year, amounting to 68,760,163 tonnes of food waste annually. Inefficient handling practices and unsuitable environmental conditions contribute to food wastage. Indian households also contribute to this issue, with the shelf life of different items varying.

Determining the freshness of food is another challenge, as stale or reduced nutritional value can lead to unnecessarily discarded items. To address this, innovative approaches are being explored, including the use of image sensors and machine learning algorithms to monitor food quality and detect spoilage. Advanced packaging technologies like vacuum packaging and modified atmosphere packaging are also being used to extend food item shelf life.

Education and awareness campaigns are being conducted to encourage consumers to adopt sustainable food practices, such as meal planning, composting, and donating excess food to those in need. The government is also promoting sustainable agriculture practices to reduce food waste.

Reducing food wastage is crucial for food security and sustainable development, requiring a concerted effort from all stakeholders. By adopting innovative approaches and sustainable practices, we can build a more sustainable food system.

II. LITERATURE SURVEY

The investigate paper proposes a strategy to classify nourishment categories with pictures. Picture acknowledgment is one of the most vital areas of picture preparing and computer vision. Nourishment picture classification is a special department of picture acknowledgment issue. Classification of nourishment pictures is exceptionally challenging since the dataset of nourishment pictures is exceedingly non-linear. Convolutional Neural Systems are utilized in this paper to classify nourishment pictures. CNNs are a exceptionally compelling lesson of neural systems that is profoundly successful at the errand of picture classifying, question discovery and other computer vision issues. Nourishment dataset comprising of diverse nourishment categories with 16643 pictures. is classified with CNN. An precision of 92.86% is gotten in this explore. [1].

The idea of development is exceptionally pivotal to get a great capacity period of septic natural products and vegetables. It is conceivable to declare the development of natural product by different characteristics where color of the skin is the most standard

degree for judging development. Regularly, a human's recognition can be off-base approximately development whereas the discernment is made by visualizing the skin color. This inquire about points to create a technique to distinguish and indicate the status of mango into diverse stages. The collected RGB pictures are changed over to HSV color space at the exceptionally to begin with stage of the conducted investigate. By considering the "S" channel, the gotten picture is portioned where thresholding procedure is utilized. From the sectioned picture fifteen crucial highlights are extricated. Three as well as six organize development classifications are performed based on these highlights with 94 and 88 percent of exactness in like manner. The exactness of the result demonstrates that the proposed procedure can be a making a difference hand to advance our mango natural product industry as well as our economy.[2].

Machine vision procedures are presently broadly utilized to identify the quality of natural products. Picture preparing is ordinarily the to begin with step in recognizing the quality of natural products. The handle begins by capturing the picture of the natural products utilizing raspberry pi. At that point, the picture is transmitted to the handling organize where it can extricate the fruit's highlights like shape, estimate and color. These forms are done utilizing picture handling. It makes a difference to distinguish and compare the natural product shape, estimate and color with the prepared datasets. This is done amid the preparing and testing organize. A differences of strategies for programmed division of natural products is created. Manufactured Neural Organize is the one that makes a difference to isolate the natural products based on the quality such as great, direct and spoiled natural product. The existing framework can as it were isolated the natural products into great and spoiled ones with exactness of 87.4% but our proposed framework is able of isolating the natural products into great, direct and spoiled ones with precision of 94.12%. [3].

Machine Learning is a department of Counterfeit Insights in which a framework is able of learning by itself without express programming or human help based on its earlier information and encounter. It is utilized to foresee or make choices to perform certain errands based on the preparing set that is given. In the proposed framework, picture classification is actualized utilizing Convolutional Neural Arrange (CNN). The content is at that point extricated from the classified picture utilizing Tesseract, which has executed a Long Short-Term Memory (LSTM) based acknowledgment motor. The LSTM systems are the units of Repetitive Neural Organize. The CNN performs way better on exceptionally huge datasets, by overcoming the issue of overfitting. Too, single line content extraction is supplanted by different line content extraction. Hence, the exactness of this framework can be progressed by joining a expansive dataset and expanding the number of ages. In expansion, a trial-and-error technique is utilized to decide the number of convolution and pooling layers with the number of hubs in each layer. At long last, CNNs utilize generally few preprocessing compared to other picture classification algorithms.[4].

A expansive number of inquire about endeavors have been put forward that endeavors to change a report picture to organize justifiable for a machine so that it can recognize the content or the data from the picture. OCR i.e. Optical Character Acknowledgment gives a arrangement for this. OCR is program that changes over printed content and pictures into digitized shape such that it can be controlled by machine. OCR frameworks have built up a specialty put in design acknowledgment. OCR has two categories, online and offline. The picture of the checked record goes through different stages like preprocessing, division, include extraction, etc. in arrange to recover the data from the picture. OCR is moreover prevalent among Android applications. Tesseract is one of the most widely used open source libraries for implementing OCR in Android applications. [5].

III. PROPOSED SYSTEM

Our Proposed System uses the image processing technique to determine the stage of the freshness of the given food item. It uses the Deep Learning algorithm CNN-Convolution Neural Network to classify the image. Once the user will give the image of the food item as the input, the stage is determined, its shelf life is calculated and the user is informed about the same a few days prior so that the food is consumed before it gets stale. This system also tracks the expiry date of other packaged items and informs about the same.

IV. ALGORITHMS:

CNN (Convolution Neural network):

A Convolutional Neural Network (CNN) is a specialized deep learning algorithm designed for analyzing visual data such as images. Here we are using the VGG16 architecture to create our own model in order to train the data.

VGG16, short for Visual Geometry Group 16, is a convolutional neural network architecture known for its simplicity and remarkable performance in image classification tasks. VGG16 consists of 16 layers, including 13 convolutional layers and 3 fully connected layers. It employs small 3x3 filters with a stride of 1 and 'same' padding in its convolutional layers, along with max-pooling layers to reduce spatial dimensions. The network gradually increases the depth of convolutional layers, culminating in a total of 138 million parameters. VGG16 achieves impressive results on the ImageNet dataset, winning the ImageNet Large Scale Visual Recognition Challenge in 2014. Due to its straightforward architecture, VGG16 is widely used as a base model for transfer learning in various computer vision tasks, where pre-trained weights are leveraged and fine-tuned for specific applications, making it a cornerstone in the field of deep learning for image analysis.

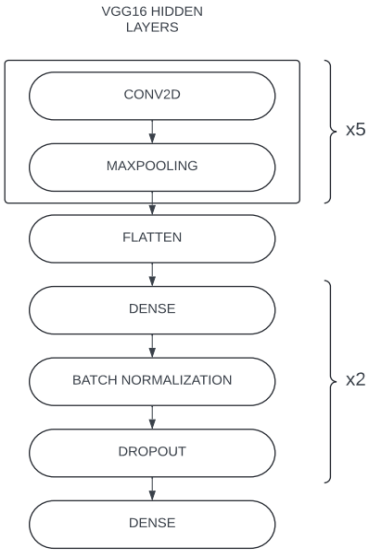
The data consists of 15 layers where 6 are convolutional2D, 6 are MaxPooling2D a flatten layer and 2 Dense layers. This layers work as follows

Convolutional (Conv2D) layer: Extracts features from the input image through convolution with learnable filters and applies ReLU activation for non-linearity.

MaxPooling2D layer: Reduces spatial dimensions of feature maps by selecting the maximum value within small windows, aiding computational efficiency and feature robustness.

Flatten layer: Converts the multidimensional output from previous layers into a one-dimensional array, preparing it for input into fully connected layers.

Dense (fully connected) layer: Neurons are connected to every neuron in the previous layer, performing a weighted sum of inputs followed by an activation function. In this model, it learns complex patterns and produces output probabilities for classification.



TesseractOCR:

Tesseract OCR, or Optical Character Recognition, is an open-source software program designed to recognize and extract text from images and scanned documents. It was originally developed by HP Labs and later maintained by Google.

Tesseract OCR operates through a series of steps: first, it pre processes the input image, enhancing quality by reducing noise and correcting text orientation. Then, it detects text areas within the image using pattern recognition and feature extraction. After identifying these regions, Tesseract utilizes neural networks and language models to analyze individual characters and words, comparing image patterns with trained data to recognize text. Finally, it conducts post-processing to enhance accuracy, addressing errors and formatting. Tesseract's versatility extends to for extracting text from images, applicable in tasks like document scanning and automated data entry.supporting various languages and the ability to be trained for specific fonts and languages, making it a valuable tool.

V. METHODOLOGY

To address the challenge of tracking the freshness and categorization of fruits and vegetables, we have devised a comprehensive solution centered around leveraging machine learning techniques and optical character recognition (OCR) technology. Initially, we formulated a fruit and vegetable classification problem to discern the category of produce provided. This classification serves as the foundation for our model, aiding in the subsequent assessment of their staleness. A Convolutional Neural Network (CNN) model was employed for predictive analysis, pre-trained to accurately classify and predict staleness levels. The dataset utilized for training was meticulously curated from diverse sources including Kaggle and Google Images. During training, the model undergoes data transformations to enhance robustness and efficacy. Following training, the model is employed to predict the staleness of test data, with subsequent evaluation of accuracy.

In tandem with the classification model, we implemented an OCR solution utilizing Tesseract OCR technology to extract expiration dates printed on packaged foods. This extracted date is then integrated into a calendar system within our Flutter application. The calendar serves as a repository for tracking the freshness of fruits and vegetables, enabling users to monitor their produce's expiration dates effectively. This combined approach seamlessly merges machine learning capabilities with OCR technology and intuitive user interface design to provide users with a comprehensive tool for managing produce freshness and categorization.

In addition to the technical components of our solution, it's essential to highlight the underlying methodologies and benefits inherent in our approach. By formulating the fruit and vegetable classification problem, we not only enable precise categorization but also establish a crucial framework for understanding produce freshness. The utilization of a CNN model underscores our commitment to leveraging state-of-the-art deep learning techniques, ensuring accuracy and reliability in classification and staleness prediction tasks.

Furthermore, the meticulous curation of our dataset underscores the importance of data quality in machine learning endeavors. By sourcing data from diverse repositories such as Kaggle and Google Images, we ensure comprehensive coverage of produce

varieties, enhancing the model's generalizability and robustness. Moreover, the application of data transformations during model training exemplifies our dedication to optimizing model performance and mitigating potential overfitting issues.

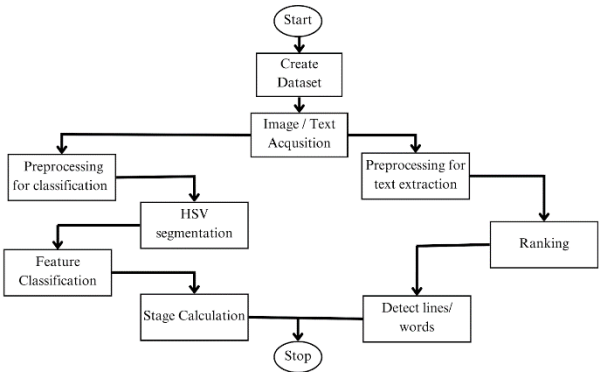


Fig 2 System architecture

The integration of Tesseract OCR technology represents a strategic augmentation of our solution, extending its utility beyond produce classification to encompass packaged foods as well. This integration underscores our commitment to versatility and adaptability, catering to the diverse needs of users in managing food freshness. The calendar system developed using Flutter provides a user-friendly interface for visualizing and tracking produce expiration dates, enhancing user engagement and facilitating proactive management of food inventory.
In summary, our solution represents a holistic and synergistic fusion of cutting-edge machine learning techniques, OCR technology, and intuitive user interface design. By addressing the dual challenges of produce categorization and freshness tracking, we empower users with the tools they need to make informed decisions and optimize food management practices.

VI. PROCEDURES

1. Problem Statement Definition: Clearly define the objective of the project, which is to develop a system for classifying fruits and vegetables and tracking their staleness levels.

2. Data Collection: Gather a diverse dataset of images containing various fruits and vegetables along with their corresponding labels (categories). Utilize sources such as Kaggle, Google Images, or other online repositories to collect the dataset. Ensure the dataset is balanced and representative of different types of fruits and vegetables.

3. Model Architecture Selection: Choose a Convolutional Neural Network (CNN) architecture suitable for image classification tasks. Common choices include ResNet, VGG, Inception, or MobileNet. Consider using a pretrained model to leverage transfer learning, which can accelerate training and improve performance.

4. Data Preprocessing: Resize all images to a uniform size suitable for input to the chosen CNN architecture. Normalize pixel values to a common scale (e.g., [0, 1] or [-1, 1]). Augment the dataset by applying transformations such as rotation, flipping, or scaling to increase the diversity of training examples and improve model generalization.

5. Model Training: Split the dataset into training and validation sets (e.g., 80% for training, 20% for validation). Load the pretrained CNN model and fine-tune it on the training data using techniques like gradient descent optimization. Monitor the model's performance on the validation set to prevent overfitting and adjust hyperparameters if necessary. Train the model until convergence or until performance plateaus.

6. Model Evaluation: Evaluate the trained model on a separate test dataset to assess its performance metrics such as accuracy, precision, recall, and F1 score. Analyze the confusion matrix to understand the model's performance on different categories of fruits and vegetables. Fine-tune the model if necessary based on the evaluation results.

7. Expiration Date Tracking: Integrate Tesseract OCR technology into the system to extract printed date information from food packaging. Develop a preprocessing pipeline to enhance the OCR accuracy, such as image binarization, noise reduction, or perspective correction. Implement a mechanism to parse and interpret the extracted date information accurately.

8. Calendar Integration: Develop a calendar feature using the Flutter framework to provide a user-friendly interface for tracking the freshness of fruits and vegetables. Design the calendar UI to display expiration dates extracted from packaged foods and allow users to input and visualize the staleness levels of perishable items. Implement functionalities such as notifications or reminders to alert users when items are nearing their expiration dates.

VII. RESULTS

In our project focused on stale detection of fruits and vegetables, we have successfully developed a model that achieves an accuracy rate of 88%. This accuracy rate signifies the model's capability to accurately distinguish between fresh and stale produce with a high degree of confidence.

Our model has been trained on a dataset comprising two types of fruits and two types of vegetables, and during evaluation, it demonstrates an impressive performance in classifying the freshness status of these food items. The achieved accuracy of 88% underscores the effectiveness and reliability of our model in real-world scenarios.

This high accuracy rate is a testament to the robustness of our approach and the effectiveness of the employed machine learning techniques. It instills confidence in the practical utility of our model for applications such as food quality preservation and waste reduction.

While celebrating this milestone, it's important to acknowledge that further refinements and optimizations can be pursued to enhance the model's performance even further. Nonetheless, achieving an accuracy of 88% represents a significant achievement in our project, reflecting our commitment to developing impactful solutions for addressing food quality challenges.

VII. CONCLUSION

This app leverages the power of image processing and machine learning to combat food waste, empowering individuals to make informed decisions about their groceries. By automating the task of shelf life tracking, This app transcends manual methods, offering accuracy, convenience, and personalized insights. This app seamlessly integrates into daily routines, fostering responsible consumption habits and minimizing food spoilage.

However, the true impact of This app lies not just in individual fridges, but in its potential to ripple outwards. By raising awareness about food waste and providing practical solutions, This app can contribute to a more sustainable food system. Imagine grocery stores implementing similar image recognition at checkout, optimizing inventory management and reducing waste throughout the supply chain. Furthermore, the data collected by This app can inform broader initiatives to improve food production, distribution, and consumption patterns.

In conclusion, This app is not merely an app, but a stepping stone towards a future where food is valued and utilized responsibly. By harnessing technology for good, This app empowers individuals, fosters sustainability,and paves the way for a more mindful relationship with food.

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