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Fruit Quality Detection

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Abstract: One of the important quality features of fruits is its appearance. Appearance not only influences their market value, the preferences, and the choice of the consumer, but also their internal quality to a certain extent. Our project presents a Computer Vision based technology for fruit quality detection. This will be implemented in python using CNN. In this project, we will use an external web cam to capture the real time image of a given fruit. This web cam will be connected to a computer device. Using our software, it will analyze the given fruit and checks whether it has any abnormalities like black or brown spots or uneven texture. These indications help us to identify the quality of the given fruit. The use of this technology can significantly improve agriculture & fruit industry as well as computer vision systems provide rapid, economic, hygienic, consistent, and objective assessment which provides people with a healthier lifestyle.

Keywords: CNN

I. INTRODUCTION

India is an agriculture country. Different types of fruits and vegetables are produced in India. India is at second number after China in production fruit. It is difficult in industry to classify the quality of fruits using traditional method so the image processing technique was introduced to classify the fruits [1]. Indian economy based on agriculture, so automation of agriculture and agriculture related industry plays important role. Post-harvest process of fruits is completed in several steps: washing, sorting, grading, packing, storage, and transporting[3]. Agriculturally efficient countries like Israel and Australia have manifested active use of this modern technology and it needs to be inoculated to Indian Fruit Industry. The targeted beneficiaries from this project include farmers, Indian, who cannot afford cost of today's fruit processing facilities. One of the important quality features of fruits is its appearance[2].Appearance not only influences their market value, the preferences, and the choice of the consumer, but also their internal quality to a certain extent. Computer vision and image processing techniques have been found increasingly useful in the fruit industry, especially for applications in quality detection.

Research in this area indicates the feasibility of using computer vision systems to improve product quality. The use of computer vision for the inspection of fruits has increased during recent years[4]. The market constantly requires higher quality products and consequently, additional features have been developed to enhance computer vision inspection systems[6] . Computer application in agriculture and food industries has been applied in the areas of inspection of fresh products. Rotten fruits can have a significant impact on a large scale, affecting both the economy and the environment. When fruits go bad, they release a variety of harmful gases that can cause negative consequences for people, plants, and animals.

II. IMPLEMENTATION

A. CONVOLUTIONAL NEURAL NETWORK

Convolutional Neural Network (ConvNet/CNN) is a Deep Learning algorithm that can take in an input image, assign importance (learnable weights and biases) to various aspects/objects in the image, and be able to differentiate one from the other. The pre-processing required in a ConvNet is much lower as compared to other classification algorithms[5] . While in primitive methods filters are hand-engineered, with enough training, ConvNets can learn these filters/characteristics. Convolutional neural networks are distinguished from other neural networks by their superior performance with image, speech, or audio signal inputs.

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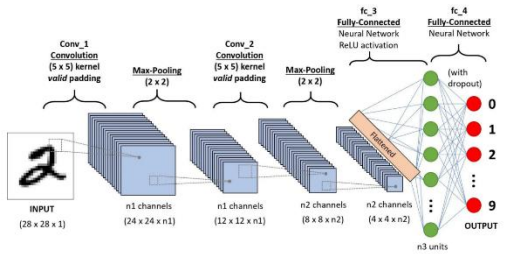

Fig 1 CNN Architecture

B. VGG16 ARCHITECTURE

VGG16 is a type of CNN (Convolutional Neural Network) that is considered to be one of the best computer vision models to date [6]. VGG16, also known as the Visual Geometry Group 16-layer Convolutional Neural Network, is a popular deep learning model used for image classification. It was developed by the Visual Geometry Group at the University of Oxford in 2014 and is one of the most influential convolutional neural networks in computer vision [7]. The creators of this model evaluated the networks and increased the depth using an architecture with very small (3 × 3) convolution filters, which showed a significant improvement on the prior-art configurations. They pushed the depth to 16–19 weight layers making it approx. 138 trainable parameters. VGG16 is object detection and classification algorithm which is able to classify 1000 images of 1000 different categories with 92.7% accuracy. One of the key features of the VGG16 architecture is its use of small 3x3 convolutional filters. The use of smaller filters also allows the network to be deeper without significantly increasing the number of parameters It is one of the popular algorithms used for image classification and is easy to use with transfer learning.

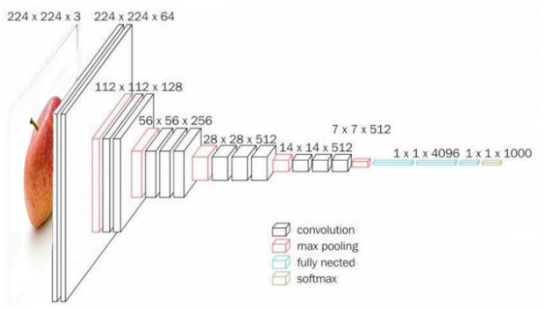

Fig 2 VGG16 Architecture

The above figure shows the architecture of VGG 16. The 16 in VGG16 refers to 16 layers that have weights. In VGG16 there are thirteen convolutional layers, five Max Pooling layers, and three Dense layers which sum up to 21 layers but it has only sixteen weight layers i.e., learnable parameters layer. VGG16 takes input tensor size as 224, 244 with 3 RGB channel. The first few layers of the VGG16 network are used to extract low-level features such as edges and corners, while the deeper layers learn more complex features such as shapes and patterns. The final layer of the network is a Softmax layer, which is used to classify the image into one of the possible categories. Most unique thing about VGG16 is that instead of having a large number of hyper-parameters they focused on having convolution layers of 3x3 filter with stride 1 and always used the same padding and maxpool layer of 2x2 filter of stride 2. The convolution and max pool layers are consistently arranged throughout the whole architecture [8]. Conv-1 Layer has 64 number of filters, Conv-2 has 128 filters, Conv-3 has 256 filters, Conv 4 and Conv 5 has 512 filters. Three Fully-Connected (FC) layers follow a stack of convolutional layers: the first two have 4096 channels each, the third performs 1000-way ILSVRC classification and thus contains 1000 channels (one for each class). The final layer is the soft-max layer.

C. USER INTERFACE

The following are the technologies we used for creating the front end of the project.

HTML

HTML (Hypertext Markup Language) is the standard markup language used to create and design web pages. It provides a set of tags or elements that define the structure and content of a web page. HTML is a foundation technology used in web development, and it is essential for creating modern and interactive web pages. HTML was developed in the early 1990s by Tim Berners-Lee, a British computer scientist who invented the World Wide Web. HTML was originally created as a simple markup language that could be easily understood by non-technical users, and it has since evolved into a powerful tool for creating rich and interactive web pages.

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CSS

CSS, or Cascading Style Sheets, is a fundamental component of web development that allows developers to style and format the appearance of web pages. CSS is a style sheet language used to describe the presentation of web pages. It is a standardized system that separates the content of a web page from its presentation. CSS is used to define the layout, color, fonts, and other visual elements of a web page, making it more visually appealing and user-friendly.

BOOTSTRAP

Bootstrap is a popular open-source front-end web development framework that is used to create responsive and mobile-first web applications. It was developed by Twitter and is now maintained by the Bootstrap Core Team. Bootstrap provides a set of pre-designed HTML, CSS, and JavaScript components, such as forms, buttons, navigation bars, modals, and more. These components can be easily integrated into a web application to create a consistent and professional-looking user interface. One of the key features of Bootstrap is its responsive grid system. The grid system allows developers to create layouts that automatically adjust to different screen sizes, making the web application accessible and user-friendly across a wide range of devices, from desktops to smartphones.

FLASK

Flask is a popular web application framework for Python that allows developers to create scalable and flexible web applications with minimal coding effort. Flask is a lightweight web framework that was first released in 2010 by Armin Ronacher. It is built on top of the Python programming language and uses the Werkzeug toolkit and the Jinja2 template engine. Flask is designed to be simple and easy to use, with a small and flexible codebase that allows developers to create web applications quickly and efficiently. Flask works by using the Model-View-Controller (MVC) architectural pattern. This pattern separates the application logic into three components: the model, which represents the data and the business logic; the view, which is responsible for rendering the user interface; and the controller, which handles user input and interacts with the model and the view. Flask provides a set of tools and features that make it easy to implement the MVC pattern in a web application.

III. RESULT

After uploading the image, we will redirect to a model prediction page in which we will get the fruit classification as well as the quality of the given fruit image is estimated. The result will be calculated in percentage accuracy. This is depicted in the figure 3

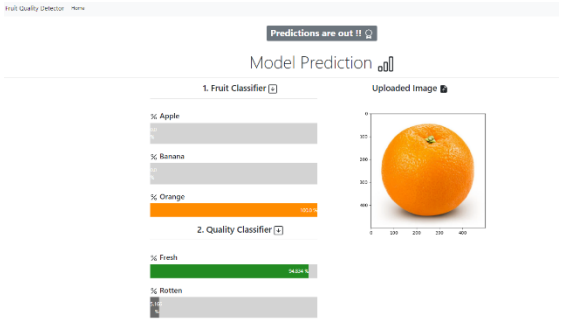

Fig 3 Model Prediction Page

Apart from image uploading feature we have the option for real time quality classification of the fruit Here a real fruit will have to place in front of the camera. After properly adjusted the fruit within the camera frame along with proper lighting, press the predict button.

Fig 4 Real Time Result

The figure 4 shows the fruit placed in front of the camera, then after pressing the predict button, it shows the fruit classification as well as fruit quality (fresh or rotten).

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IV. CONCLUSION

Based on the analysis conducted, it can be concluded that the fruit quality detection app using deep learning has the potential to revolutionize the fruit quality assessment process. This can help in reducing the manual labor required for fruit quality assessment, improving the accuracy of the assessment, and reducing the chances of errors. The deep learning algorithms used in the app are highly efficient and accurate, and can learn from a large dataset of fruit images. Additionally, the software can provide real-time results, making it a valuable tool for fruit growers, distributors, and retailers. Overall, the fruit quality detection app using deep learning has the potential to improve the efficiency and accuracy of fruit quality assessment, leading to better quality fruit and improved profitability for the fruit industry.

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