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Advancing Food safety through IoT: real time monitoring and control system

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Abstract

Diseases in fruit and vegetable cause devastating problem in economic losses and production in agricultural industry worldwide. In this project an adaptive approach for the identification of fruit diseases and vegetable is proposed and experimentally validated. In this project, this approach will be detecting the diseases which affect the fruits and can even identify some types of diseases which attacks fruits based on some comparisons. On account of that, the approach is using CNN(Convolutional Neural Networks), which is a deep learning algorithm that is where input is taken as images, and those images were differentiated based on various aspects and parameters taken from it and is most commonly applied to analyzing visual imagery. This will be definitely helpful for the farmers to enhance the growth of the crops in the mere future. For this approach, python language has been chosen for further analysis. By applying this proposed system, the accuracy level reached is 97%.

INTRODUCTION

This project aims to leverage IoT technology to revolutionize the food safety landscape. With continuous, automated monitoring and corrective control, food producers, transporters, retailers, and consumers will gain confidence in the quality and safety of food products. This not only ensures public health but also improves business efficiency and regulatory compliance, making the entire food supply chain smarter and more resilient.Food safety is one of the most critical aspects of public health. Despite advances in technology, issues such as contamination, spoilage, and improper handling still lead to foodborne illnesses and financial losses. This project aims to address these challenges by leveraging the Internet of Things (IoT) to create an intelligent, real-time monitoring and control system for food safety. Through this system, we can ensure that food is stored, transported, and handled under ideal conditions, preventing contamination and spoilage at every stage of the supply chain.

This IoT-based food safety monitoring and control system will transform how food is handled across the supply chain, ensuring optimal safety conditions from production to consumption. Diseases of fruits and vegetables seriously endanger economic loss and productivity in the agriculture sector. Fruit and vegetable infections may cause a fruit's and vegetable's quality and yield to drop off too much. Monitoring the health of fruits and vegetables and determining any infections that may be present are crucial. Modern computational methods have been used in applications related to agriculture. Automatic fruit and vegetable disease detection is

highly regarded in the field of agricultural information.

LITERATURE REVIEW

Bayu Adhi Tama, Bruno Joachim Kweka,Youngho Park, Kyung-Hyune Rhee, "A critical review of blockchain and its current applications. [11]

Hadi Saleh,Sergey Avdoshin,Azamat Dzhonov "Platform for Tracking Do nations of Charitable Foundations based on Blockchain Technology. "2019 Actual Problems of Systems and Software Engineering. [17]

Kriti Patidar, Dr. Swapnil Jain Decentralized E-Voting Portal Using Blockchain",10th ICCCNT 2019 July 6-8, 2019, IIT - Kanpur,Kanpur, India [22]

Ali Mansour Al-madani,Dr.Ashok T. Gaikwad,Vivek Mahale, Zeyad A.T.Ahmed, "Decentralized E-voting system based on Smart Contract by using Blockchain Technology.",IEEE 2021. [25]

Nikhitha .m ,"Fruit Recognition and Grade of Disease Detection using Inception V3 Model "IEEE 2019. [28]

P. Kanjana Devi ,"Image Segmentation K-Means Clustering Algorithm for Fruit Dis- ease Detection Image Processing"IEEE 2020. [30]

PROPOSED METHODOLOGY

Methodology

There are five phases in this methodology. Those areImage Acquisition, Image Pre-processing, Image Segmentation, Applying training dataset, Experimental results.

Image Acquisition

This is the first phase and in the first phase, the collection of sample images were done, these collected images were needed for the training purpose of the classifier algorithm and for building the classifier model. Reddish fruit variety is selected for acquiring sample images. Healthy and diseased fruit images were captured by using widely used mobile phone cameras and those captured images were used as the training set and test set images for the classifier algorithm. All those images were captured in quite different angles, in
various environments and under different lighting conditions. The commonly used format called "JPG" is used to save and use these images. For this classifier method, test set and training set were gathered from agricultural fields of different regions.

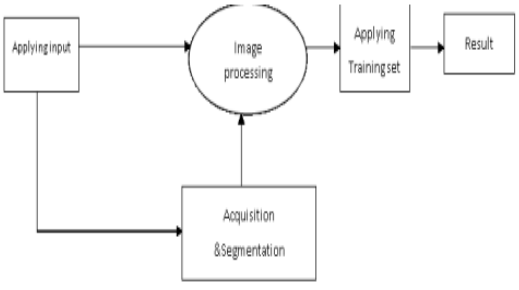


Image Preprocessing

After completion of the image acquisition process, Another thing called image processing is carried out for the purpose of improvement of the quality of the image. All original images of fruits we re collectively stored in one common folder. These images can be stored in any name as our wish. And some images which were horizontally captured, is advised to be rotated in 90 degrees and should be resized in the dimension of 200x300 pixel size. And if the height and width of the captured images were same, those images must be resized in 250x250 pixel size. The processing will be somewhatdelayed, only when the image size was big. After completing the process of image resizing, an image restoration method is used to reduce the noise and also increasing the sharpness of that image. Aftercompleting this process, all such images are saved in the same folder.

Image Segmentation

Image segmentation is the third phase of this disease detection process which is going to be done after image preprocessing. Here the first step is, all the images which are pre-processed are to be converted to L*a*b, HSV, Grey colour models and finally kept in the RGB format. As identifying the suitable colour modelled image for the process of pre-processing is also one of the proposed outcomes of this method. After this process, the image conversion was done for changing the format to binary format. This formatting values are clustered with the help of the CNN algorithm. According to the algorithm used an image segmentation were done.

Applying Training Set

The fourth phase is training the algorithm with a set of images. Segmented output was given with the help of feature extraction. For this experiment three sets of images were created. Some sets of images were prepared and that preparation process is also included here.

Experimental Results

After applying the training set images, three base folders were utilized for identifying the fruit disease according to the name of each disease. The method of counting the number of affected places is said as an alternative method. Every training and testing time, rows of training files were shuffled randomly for increasing the accuracy of the model. Average of those accuracies was taken. Using these datasets, three types of diseases were found. Such as bitter rot, powdery mildew and sooty blotch.

IMPLEMENTATION DETAILS

Data Collection Module

Project Overview: Briefly describe the project, its purpose, and its importance. Pro-vide a concise

summary of the project's background, objectives, and the problem it aims to solve.

Implementation Objectives: Outline the specific goals and objectives of the project implementation phase. What are we looking to achieve during this stage? What milestones and deliverables can we expect?

Scope of Implementation: Define the scope of the implementation phase. What aspects of the project will be addressed, and what will be the boundaries of this phase? This helps set clear expectations for the reader.

Significance of Implementation: Explain why the implementation phase is crucial for the project's success. What benefits or outcomes are expected as a result of effective implementation?

Structure of This Section: Provide an overview of what the reader can expect in this section. Mention the key topics, tasks, and steps that will be covered in the subsequent content.

Transition: With this introduction, we embark on the implementation journey, where planning transforms into action, and strategies become reality. This section will guide us through the nuts and bolts of putting our project plan into practice, offering insights, challenges, and solutions that lie ahead.

RESULT AND DISCUSSION

Dataset

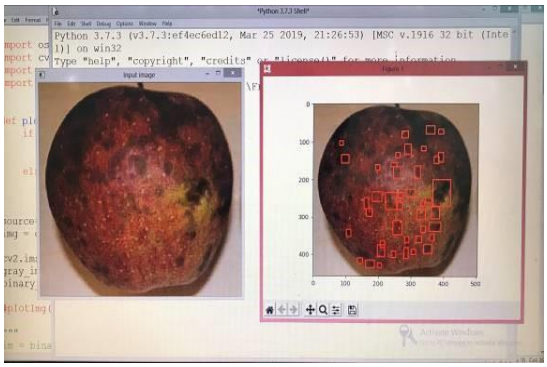
The image of the fruits, which are used for giving input for detecting the diseases were taken from the image repository named Kaggle.com.

Step 1

At the first step of the proposed method, the image of the fruit is given as input(either fresh or diseased).The image which is given as the input will be displayed first.

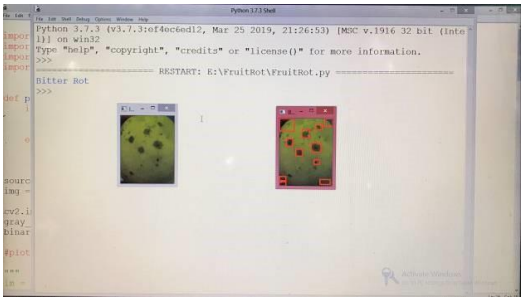
Step 2

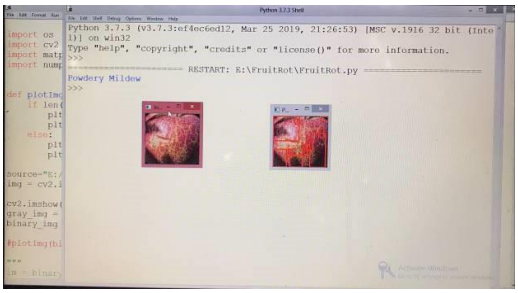
After displaying the input image, the disease affected areas will be highlighted in the second step.

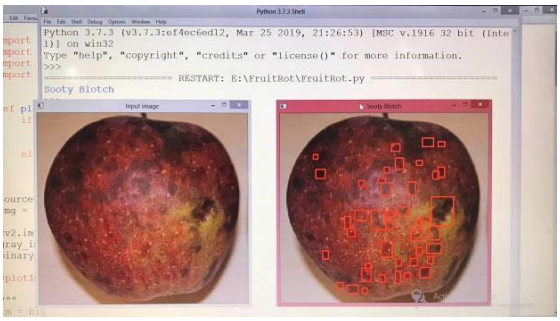


Step 3

After highlighting the disease affected areas of the fruit, if we close that tab, then the name of the disease will be shown in the python shell along with the disease highlighted image

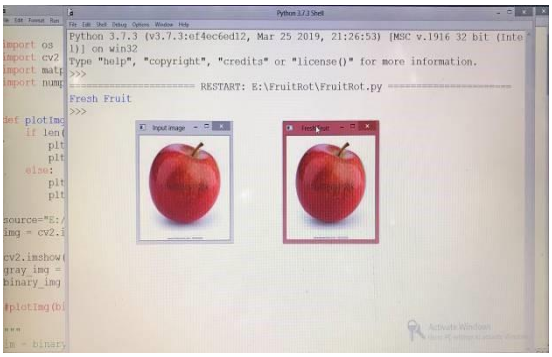






Fresh Fruit

If we give a fresh fruit as an input, then the output will say that the given input image is the "Fresh Fruit".



CONCLUSION

The plants are which are being cultivated should be disease free and pest free, so that people can contribute a good sum to global economy and can help farmers and agriculturalists to lead a good , wealthy as well as healthy life. These things can be literally achieved with the help of image processing and the proposed algorithm. The Use of CNN algorithms pave an easy way to detect the disease on the fruits and helps to classify the diseases from healthy fruit. From these methods and algorithms, this approa ch can easily identify and classify the fruits using image processing techniques. The leading objective of our project is to boost the worth of fruit disease detection.

FUTURE SCOPE

The Future Scope Of A Project Like *"Advancing Food Safety Through Iot: Real-Time Monitoring And Control System"* Is Quite Promising And Has Significant Potential For Growth. With Increasing Concerns Over Food Safety, Quality, And Sustainability, Integrating Internet Of Things (Iot) Technologies Offers Various Avenues For Improvement And Innovation.

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