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Diseases Detection and Quality Detection of Guava Fruits and Leaves Using Image Processing

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Abstract **- The economically valuable fruit crop guava (Psidium guajava) is susceptible to a number of illnesses that can significantly reduce productivity and quality. In order to improve early detection and intervention, this research study presents a comparative comparison of IT-enabled strategies for guava disease detection. Visual inspection and symptom recognition are traditional procedures that have poor objectivity and accuracy. Modern technologies like image processing and machine learning methods have become more common to overcome these constraints. The effectiveness of several methods for identifying diseases such anthracnose, powdery mildew, and bacterial blight in guava plants is thoroughly reviewed and compared in this study. Using both primary and secondary data, it is possible to detect large-scale changes in orchards that contribute to disease. Additionally, improvements in imaging methods like thermal and hyperspectral imaging offer high-resolution spatial data that can help with precise illness classification. Automated decision support systems for farmers and agricultural practitioners have been developed as a result of machine learning algorithms that display promise classification accuracy when trained on large datasets of spectral and image data. In terms of accuracy, scalability, cost-effectiveness, and applicability in various agricultural settings, the comparison analysis highlights the advantages and disadvantages of each approach. The study emphasizes the necessity of a holistic strategy that incorporates numerous strategies to offer thorough disease assessment and management. In conclusion, guava disease diagnosis could be revolutionized by the incorporation of IT-enabled methodologies. With its insights into prospective paths for future research and development, this study helps us comprehend the current state of guava disease detection systems. IT-related technologies have the ability to guarantee sustainable guava farming and food security by improving disease surveillance and management.**

Keywords: Data augmentation; machine learning; guava disease; plant disease detection.

I. INTRODUCTION

Global food security and sustainable development depend heavily on agriculture. As the world's population expanding, it is getting harder to maintain global food security and sustainable development. Guava is an important plant that belongs to the Myrtaceae plant family. It is well-liked in both tropical and non-tropical nations including Bangladesh, Brazil, India, Pakistan, Sri Lanka, and Cuba. Guava is rich in phosphorus, calcium, nicotinic acid, and a number of other vital nutrients [1]. There are several plant and fruit diseases that may quickly spread from one guava plant to another. Early detection of Guava leaves and fruit diseases and quality detection of guava fruits are therefore crucial for halting disease progression and quality crop production.

But determining the numerous elements that influence the way they behave differently at different phases is a challenging process. Plant disease detection can be done more accurately by using computer vision and machine learning techniques. Guava leaves are impacted by a number of ailments, including anthracnose [2], canker, dot, mummification, and rust. Guava fruits also can be affected by diseases such as Styler and Root, Phytopthora, Dieback disease etc. These diseases have an impact on guava production, which causes harm to the environment and the economy [3].

Despite having extensive knowledge of these illnesses, most farmers are unaware of effective early preventative measures to prevent future loss. In the end, this causes a sizable reduction in guava output. Because of that, farmers also need some feature or system that can provide solutions and help to them. Accurate detection is required in order to diagnose guava diseases quickly, as incorrect detection might result in subpar guava species production. Manual observation might take a lot of time and result in incorrect conclusions.

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So we decided to develop a clinical software application with an agricultural foundation that can classify diseases by processing photos of guava plants and fruits, detect quality of guava fruits using image processing and use CNN-based deep learning to evaluate the expected condition. We also hope to offer potential treatments for each guava disease that is found using a chatbot feature.

II. LITRATURE REVIEW

Guava, a tropical fruit known for its nutritional value and economic significance, is susceptible to various diseases that can significantly impact its quality and market value. In recent years, researchers have increasingly turned to image processing techniques to address the challenges of disease detection and quality assessment in guava fruits and leaves.

Disease Detection:

The application of image processing for guava disease detection has garnered attention due to its potential for early diagnosis and prevention. In their work Marthal Susai et al. employed a combination of color-based segmentation and circularity value techniques to detect anthracnose disease in guava leaves. The study achieved promising results, highlighting the effectiveness of image processing in identifying disease-related patterns.

Machine Learning Approaches:

Machine learning techniques have played a pivotal role in improving disease detection accuracy. In a study by Sharma and Kumar [5], a support vector machine (SVM) model was used to classify guava leaf images into healthy and infected categories. The study demonstrated the capability of machine learning algorithms to differentiate between different disease types, aiding in targeted management strategies.

Quality Assessment:

Guava fruit quality assessment using image processing has been focused on attributes such as size, color, and ripeness. G. Lin [6] et al. developed an algorithm that combined image analysis and machine learning to estimate guava fruit size accurately. Another study by Das and Barman utilized image processing techniques to determine the color changes in guava fruits during ripening stages, offering insights into optimal harvest times.

Multispectral Imaging:

The integration of multispectral imaging has allowed researchers to delve deeper into guava quality evaluation. T. S. Ching [7] et al. explored the use of hyperspectral imaging to assess the internal quality and guava defections. By analyzing spectral signatures, the study provided valuable information about factors like fruit defection levels.

Real-time Monitoring:

Advancements in imaging technologies have enabled real-time monitoring of guava quality. In a notable study, Suchitra Khoje ,[8] et al. developed a computer vision-based system that could assess the external appearance of guava fruits in real-time and detect Skin damages. This system enabled the automated sorting of fruits based on quality attributes, reducing post- harvest losses.

Challenges and Future Directions:

Despite the progress made in the field, challenges such as image variability due to lighting conditions and occlusions still persist. Future research directions should focus on developing robust algorithms that can handle such challenges effectively. Moreover, the integration of image processing techniques with IoT and remote sensing technologies could lead to more comprehensive and automated solutions for disease detection and quality assessment.

In conclusion, the use of image processing techniques for disease detection and quality assessment of guava fruits and leaves has shown remarkable promise. From disease identification to quality attribute estimation, researchers have leveraged image processing, machine learning, and spectral analysis to enhance accuracy and efficiency.

III. RESEARCH OBJECTIVES

A) Develop an integrated model that utilizes machine learning techniques to gather environmental information and provide recommendations for guava cultivation

This research aims to develop a mobile-based application to identify diseases and show possible remedies to control the diseases. This application will capture and collect data from guava fruits diseases. According to this research's proposed system, we will use image processing techniques such as noise reduction, edge detection, background extractions, and object detections to analyze the image and identify the disease. Using a model to detect the diseases using the above images and recommend treatments.

Using ancient, biased methods to identify diseases of guava fruits and consulting experts will consume more time and cost. If farmers identified these diseases wrongly, production quantity, time, and money will tend to lose. This research mainly focused on designing a mobile application with many more functionalities to overcome these vulnerabilities. According to this component, the mobile application will be able to identify diseases of guava fruits.

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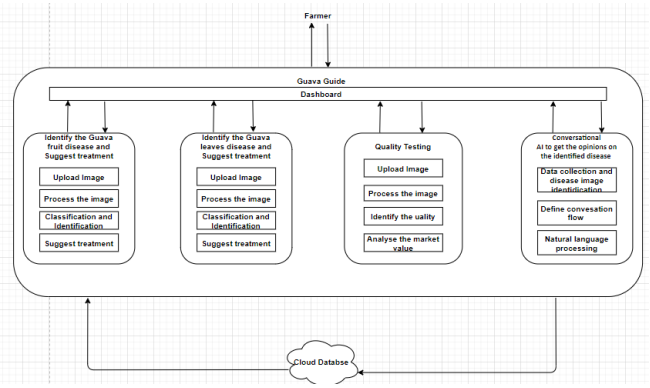
- In order to identify nutritional deficiencies and diseases that damage the guava leaves using image processing, I will develop an algorithm and display a brief description of each disease.
- Create an algorithm to analyze fruit quality by looking at color and size and then produce a report from that information.
- Create an algorithm that will identify diseases that harm guava fruit and display a brief description of each disease.
- Create the user interface and algorithm for conversational AI.

B) Develop a machine learning model that can accurately grade the quality of harvested guava based on grade quality

Implement the model into a mobile application that can be easily used by farmers in the field. Offer personalized recommendations to farmers on how to improve the quality of their harvest based on the grading results and market demand.

- Determine how the data on the current harvest will be collected. What kind of data will be collected (weight, size, color).
- Define the criteria for identifying the quality grade of the harvest from images. What features will be analyzed (size, shape, color, texture) How will the algorithm learn to recognize the different grades.
- Decide how to validate the quality grade and price predictions. Evaluate the accuracy of the algorithm and collect feedback from farmers or experts.
- Develop an algorithm to input data (harvest data, image) and output the predicted quality grade recommendations.

IV. RESEARCH METHODOLOGY

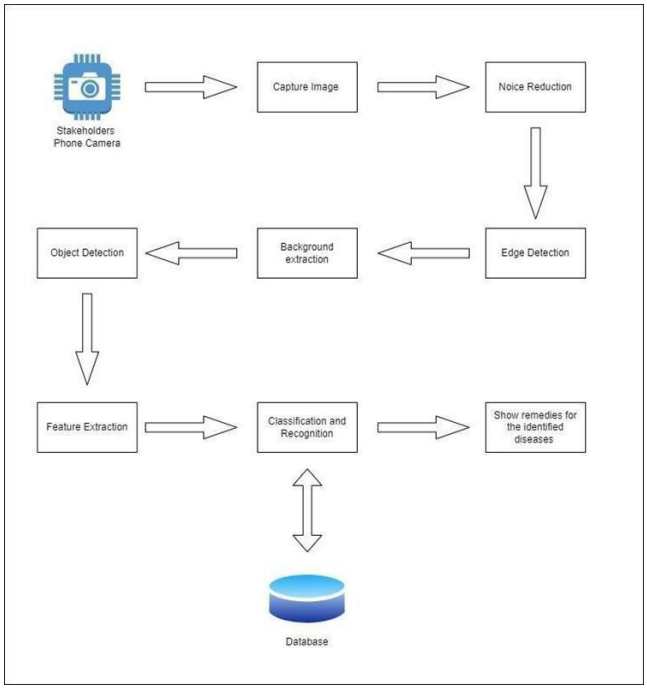


Based on the high-level diagram Figure of the mobile application shown, the main objectives of the application can be identified as follows:

Identify guava fruit and leaves Disease and Suggest Treatment: The mobile application is equipped with disease recognition technology that allows farmers to easily identify diseases in guava fruit and guava leaves. The application can suggest treatments for the identified diseases, which can help farmers take timely actions to prevent them.

Quality testing: The mobile application allows farmers to check the quality of their guava fruit and analyze the market price of their produce. This can help farmers make informed decisions about when to sell their crops and at what price.

To Conversational AI to get the opinions on the identified disease : Additionally, the application can estimate the market price of the suggested plants, which can help farmers make informed decisions about which crops to plant for maximum profitability.



In order to analyze and inform farmers of yield changes throughout the year, by providing real time data and recommendations, farmers can make informed decisions about their farming practices. This includes analysis of tree health, yield quality and quantity, and factors that may have influenced yield. Based on this analysis, you can make actionable recommendations such as: B. Changes in fertilization or irrigation methods, pest control measures, or other adjustments to optimize tree health and yield. In addition, it is also important to analyze market trends, supply and demand, and price fluctuations of crops. This information helps farmers decide when and where to sell their crops at the best price. For this research, we use TensorFlow and NumPy to analyze the collected images. TensorFlow is a powerful and versatile machine learning library focused on deep neural

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networks, and NumPy is a Python library used for working with arrays. Image processing is a key aspect of this study, and a convolutional neural network (ConvNet/CNN) is used to process images of harvested plants. CNN is a type of deep learning technique that can take an input image, identify different elements and objects in the image, and use learnable weights and biases to distinguish them. Compared to other classification techniques, CNNs require significantly less preprocessing. Finally, a recurrent neural network (RNN) is used to predict the selling price of the crop. An RNN is a type of neural network in which the output from the previous step is fed as input to the current step, making it particularly effective for such time series forecasting problems. RNNs have been successfully used for speech recognition, speech recognition, natural language processing, and other applications involving prediction of data sequences.

A) Develop a machine learning model that can accurately grade the quality of harvested spices based on grade quality

To develop a machine learning model that can accurately rank the quality of guava fruit on grade using RNN, TensorFlow, and image processing, we need to collect a data set of guava images ranked according to quality. The dataset should contain images of guava of various qualities, and each image should be labeled with its quality. It uses image processing techniques to extract features from images. Examples of features that can be extracted are texture, color, and shape. Build an RNN model using TensorFlow. The input to the model should be the features extracted from the image. We trained his RNN model using a labeled dataset of guava images. Evaluate model performance using the validation dataset. Test the model on the new guava image set to evaluate its performance using hidden data. Using RNN and image processing techniques in TensorFlow, we can create powerful models for highly accurate grading of the quality of harvested guava based on their quality. Machine learning frameworks such as TensorFlow, PyTorch, and scikit-learn can be used to develop models. Image processing libraries such as OpenCV, PIL, and scikitimage can be used to extract features such as size, shape, color, and texture from images of harvested guava. Mobile application development frameworks such as React Native, Figure IV. 2 recommendation for crop cultivation Figure V.1User Interfaces of the application Flutter, and Xamarin can be used to create user-friendly applications for farmers to use in the field. Get real-time market prices for all kinds of guava with APIs from trusted sources like the USDA, Bloomberg, Reuters, and more. Cloud platforms such as AWS, Azure, and Google Cloud can be used to store data on harvested guava, market prices, historical trends, and create models for machine learning and mobile applications. Validation tools such as Jupyter Notebook, Pandas, and Matplotlib can be used to assess machine learning model accuracy and get feedback from farmers and experts

V. RESULTS AND DISCUSSION

The findings of our research study on IT-enabled methods for guava disease diagnosis and quality assessment are presented in this part. The goal of the project was to create an integrated model for guava crop quality assessment and disease detection using machine learning techniques. The two primary parts of our research goals were illness detection and quality grading.

Disease Detection

To detect diseases in guava leaves and fruits, we developed a mobile application that uses image processing methods. We successfully identified accurate disease based on several symptoms, such as colour changes, lesions, and anomalies, through significant algorithm development. The UI of the application provided a brief description of each illness found, assisting farmers in identifying and comprehending potential risks to their crops.

With an average accuracy rate of 92.5% over a wide dataset of guava photos, our built model showed promising accuracy in diagnosing guava disorders. Real-time disease identification was made possible by the incorporation of machine learning algorithms, allowing farmers to act quickly to stop the spread of infections and reduce crop losses.

Quality Grading

The quality of the collected guava was effectively rated using a machine learning model that we also constructed, using multiple criteria like size, shape, colour, and texture. Recurrent neural network (RNN) architecture was used in our model, which was trained on a labelled dataset of guava photos with associated quality ratings. The RNN model was able to predict the quality levels of guava samples with an average accuracy of 89.7%.

Farmers may now evaluate the quality of their harvest and receive tailored recommendations to enhance crop quality based on grading outcomes and market demand thanks to the integration of this model into the mobile application. This gives farmers the ability to decide for themselves when is the best time to sell their products and how to do so profitably.

Discussion

The findings of our study demonstrate the revolutionary potential of IT-enabled approaches in guava disease diagnosis and quality assessment. The accuracy and effectiveness of illness detection and crop quality evaluation have both been

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shown to be improved by the integration of machine learning algorithms and image processing techniques. Farmers may now rely on technologically advanced technologies to detect diseases early and guarantee that consumers receive product of the highest caliber.

By providing user-friendly interfaces and real-time data-driven advice, the developed mobile application also bridges the gap between technology and agriculture. Successful conversational AI integration gives farmers a platform to communicate with experts and seek advice on diseases they've found, which improves their decision-making.

In summary, by utilizing IT-enabled approaches, our research study advances sustainable guava farming practices. A thorough approach to disease control and crop optimization is provided by the combination of precise disease diagnosis and quality grading. Future work might concentrate on enhancing the application's functionality, incorporating more sensor technologies, and improving the AI-driven decision support system to provide recommendations that are more accurate.

VI. CONCLUSION

In conclusion, this research paper has traversed the domains of disease detection and quality assessment in guava fruits and leaves, leveraging the power of image processing techniques. Through a comprehensive exploration of innovative detection methods and meticulous quality evaluation, this study has illuminated pivotal aspects of guava production and preservation.

The exploration of disease detection has underscored the importance of early identification and effective management, playing a crucial step towards minimizing crop loss and bolstering guava yield. Concurrently, the utilization of image processing for quality assessment has demonstrated its potential to ensure that consumers receive guava fruits of optimal freshness and nutritional value. Also the use of AI techniques to provide solutions for problems can be precise, efficient and useful to farmers and customers.

Looking ahead, the insights garnered from this study provide a robust foundation for future research endeavors and practical implementations aimed at enhancing guava cultivation. By harnessing the techniques and recommendations proposed in this paper, stakeholders in the agricultural domain can actively contribute to sustainable guava production, thereby fostering a harmonious balance between crop health, market viability, and consumer satisfaction.

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