International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 01 | Jan - 2025 SJIF Rating: 8.448 ISSN: 2582-3930

Online Inspection of Packed Cases

[1] D Sai Eswara Reddy, [2] K Dinesh, [3] D Niranjan Reddy, [4] N Pavan Kumar, [5] B Harinath Reddy, [6] Sukruth Gowda M A

[1,2,3,4,5] UG Student Dept. Of CSE, [6] Professor Dept. Of CSE

[1,2,3,4,5,6] Presidency University, Bengaluru-560064

Abstract— This paper presents a novel approach to automate the inspection process of packed agricultural cases using Artificial Intelligence (AI) and image processing techniques. The current manual inspection system, which assesses only 10% of packed cases based on subjective expert judgment, faces limitations such as inefficiency, subjectivity, and an inability to scale. The proposed solution leverages AI models and advanced image processing algorithms to perform real-time, automated inspections of packed cases. The system assesses quality based on predefined parameters like color, ripeness, and uniformity, as per customer specifications. This approach offers numerous benefits, including increased accuracy, scalability, cost reduction, and enhanced customer satisfaction.

***Keywords*—** *Artificial Intelligence (AI), Image Processing, Online Inspection, Quality Control Automation, Agricultural Products, Real-Time Feedback, Machine Learning, Objectivity in Inspection, Automated Quality Assessment, Case Inspection.*

Introduction

The inspection of packed cases is crucial in maintaining product quality and ensuring customer satisfaction. Current inspection methods rely on human experts, which limits scalability and introduces subjectivity in judgments. Only 10% of packed cases are inspected, leading to missed defects and delayed corrective actions. By leveraging AI and image processing, this project seeks to automate and improve the quality inspection process, ensuring uniformity, real-time results, and a reduction in human error.

A. Existing Method Drawbacks

The current inspection process is manually operated and relies on human expertise, which is prone to subjectivity and errors. The drawbacks include:

- Inability to inspect more than 10% of cases due to space and manpower limitations.
- Delayed inspections (one day after packing), making real-time corrective actions difficult.
- High variability due to human involvement, influenced by business and environmental factors.

B. Proposed Method

This system automates the visual inspection process using AI and image processing techniques. The software analyzes images of packed cases to detect issues related to color, ripeness, and uniformity. By applying machine learning models, the system provides a real-time, consistent, and scalable solution that can inspect 100% of the cases. This enhances product quality and reduces costs associated with defective products.

II. METHODOLOGY/MODULES

- **Image Acquisition:** Collect images of packed cases using cameras installed in the inspection line.
- **Preprocessing**: Convert images to appropriate formats, apply noise reduction, and enhance image quality.
- **Feature Extraction**: Extract relevant features, such as color and texture, using image processing techniques.
- **Classification**: Use AI models (e.g., SVM) to classify cases based on predefined quality criteria.
- **Feedback Mechanism**: Allow users to provide feedback on the inspection results for continuous improvement of the system.

A. Abbreviations and Acronyms

AI: Artificial Intelligence, **ML**: Machine Learning, **SVM**: Support Vector Machine, **RGB**: Red, Green, Blue (color model), **HSV**: Hue, Saturation, Value (color model), **CV**: Computer Vision, **UI**: User Interface, **API**: Application Programming Interface, **CNN**: Convolutional Neural

Network, **DL**: Deep Learning, **RTP**: Real-time Processing, **QA**: Quality Assurance.

B. Architechture

The system architecture includes an image acquisition module, image preprocessing, feature extraction, classification using machine learning models, and a feedback mechanism. The system is integrated into a web interface for user interaction, allowing users to upload images and view results in real time.

C. Hardware/software components

- **Hardware:**

GPU (optional) for fast training of the CNN model.

Standard CPU for running the Django application.

- **Software:**

Python 3.7+

Django Web Framework

TensorFlow/Keras for deep learning model development.

OpenCV for image preprocessing.

HTML, CSS, JavaScript for the frontend design.

Database (SQLite/MySQL) (optional for storing records).

III. Expected Outcomes

- Real-time inspection of 100% of packed cases.
- Reduced error rates in quality assurance.
- Improved customer satisfaction through enhanced product quality.

IV. A NEW PARADIGM IN ONLINE INSPECTION OF PACKED CASES

The proposed AI-powered inspection system marks a significant shift from manual operations to automated, data-driven processes. By using AI algorithms trained to recognize defects and deviations based on the customer-approved master case, the system can evaluate each packed case in real time. Image processing techniques, coupled with deep learning models, enable the software to analyze color, ripeness, and uniformity across thousands of cases, ensuring consistent quality standards.

This paradigm shift introduces several key innovations:

- **Real-Time Inspection**: Instead of waiting for experts, AI can inspect each case as it is packed, enabling immediate feedback and corrective actions.

- **Scalability**: The system can inspect 100% of the cases rather than just 10%, eliminating the need for manual inspection.

- **Objectivity**: AI eliminates human subjectivity, ensuring uniform assessment based on predetermined quality metrics.

- **Data-Driven Insights**: The software provides valuable insights on quality trends and defects, which can help optimize the production process.

- **From Manual to Automated Inspection** Traditionally, inspection of packed cases is performed manually by experts who assess product quality based on their subjective judgment and experience. This process is not only time-consuming but also limited in scalability, as businesses can only inspect a small percentage of cases (typically 10%) due to manpower and space constraints. This often results in undetected defects reaching the customer.

  The new paradigm replaces manual inspection with automated, AI-driven systems. Using high-resolution cameras and image processing algorithms, each packed case can be inspected in real time, immediately after it is processed. This eliminates the reliance on human inspectors and the inherent subjectivity in the process. Every case can be inspected for parameters like color, ripeness, and uniformity, as defined by the customer, ensuring consistency and eliminating the risk of shipping defective products.

- **Real-Time, In-Line Inspection**

  One of the key advantages of AI-powered inspection is the ability to perform real-time, in-line inspection directly on the production line. In the traditional model, inspections often occur after the fact, usually a day after the product has been packed, which creates delays and limits the ability to take immediate corrective action.

With AI and image processing systems, the inspection happens concurrently with the packing process, allowing for instant feedback. If a deviation from the quality standard is detected, the system can trigger an alert, allowing production staff to take immediate corrective actions. This proactive approach ensures that any defects can be addressed on the spot, improving overall product quality and minimizing rework or product wastage.

- **Objectivity and Consistency in Quality Control**

Manual inspections are inherently subjective. The perception of color, ripeness, and uniformity may vary between different inspectors, leading to inconsistent quality assessments. Environmental factors like lighting, inspector fatigue, and pressure to meet production targets further contribute to the variability in inspections.

By contrast, AI-driven inspection systems are based on objective, pre-defined criteria. These systems analyze images using trained machine learning models that recognize specific patterns and characteristics indicative of quality or defects. As a result, every packed case is evaluated against the same standards, ensuring uniformity and fairness in the inspection process. This objectivity reduces variability and ensures that the same quality metrics are applied to every product.

- **Enhanced Scalability: Inspecting 100% of the Packed Cases**

Current manual inspection systems are limited by time and labor, which means that only a small percentage of packed cases (around 10%) can be inspected. This leaves a significant portion of the product unchecked, increasing the risk of undetected defects.

With AI-based systems, scalability is no longer an issue. The automation and speed of image processing allow for 100% inspection of all packed cases. Every single case can be inspected for conformity to customer specifications without adding significant time or labor costs. This not only meets customer expectations but also ensures that defective products are detected and removed from the supply chain before shipment.

V. LITERATURE REVIEW

A. "Deep Learning. MIT Press."

1) Author/s of only this affiliation: Goodfellow, I., Bengio, Y., & Courville, A.

a) Algorithms Used: **Deep Neural Networks (DNNs):** The book covers a wide range of deep learning architectures such as Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), and generative models like Generative Adversarial Networks (GANs).

b) Drawbacks:

Computationally Expensive: Training deep networks requires a lot of computational power and memory.

Overfitting: Deep networks can easily overfit, especially when trained on small datasets.

B. "YOLOv3: An Incremental Improvement."

1) Author/s of only this affiliation: Redmon, J., & Farhadi, A.

2) Algorithms Used: **Darknet-53 Backbone**: YOLOv3 uses Darknet-53, a 53-layer convolutional neural network, as its backbone. This network is pre-trained on ImageNet, allowing it to perform feature extraction from images efficiently.

3) Drawbacks:

Lower Accuracy for Small Objects: Although YOLOv3 performs better on smaller objects than its predecessors, its performance on very small objects is still not as accurate as models like Faster R-CNN or SSD. Small objects may be missed or poorly localized.

C. Figures and Tables

Fig 1

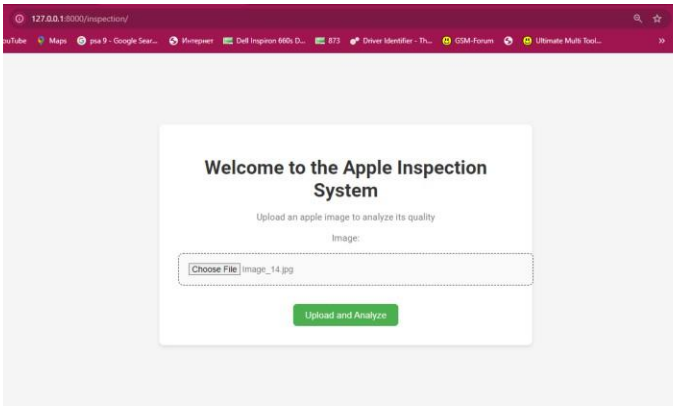

Fig 2

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 01 | Jan - 2025 SJIF Rating: 8.448 ISSN: 2582-3930

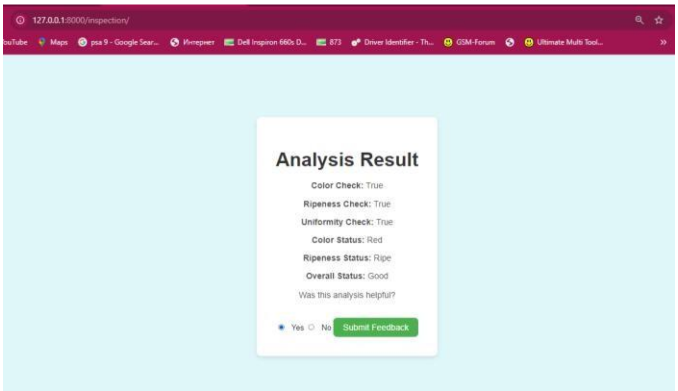

Fig 3

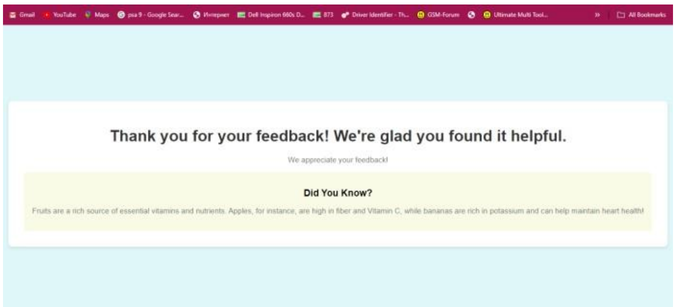

Fig 4

a.

Acknowledgment

We B. Harinath Reddy, D. Sai Eswara Reddy, K Dinesh, D Laxmi Niranjan, Nookala Pavan would like to thank Dr,Sukruth Gowda, Professor at Presidency University, for their valuable support and guidance throughout this project. We would also like to extend our gratitude to Presidency University for providing the necessary resources and facilities for the successful completion of this work.

Lastly, we are grateful to our families and friends for their unwavering encouragement and support.

REFERENCES

- Russakovsky, O., Deng, J., Su, H., et al. (2015). "ImageNet Large Scale Visual Recognition Challenge." *International Journal of Computer Vision*, 115(3), 211-252.
- LeCun, Y., Bengio, Y., & Hinton, G. (2015). "Deep Learning." *Nature*, 521(7553), 436-444.
- Zhang, X., Li, Z., and Cai, Y. (2019). "Image Processing Techniques for Quality Inspection in Manufacturing." *IEEE Transactions on Industrial Electronics*, 66(7), 5079-5090.
- Redmon, J., Divvala, S., Girshick, R., & Farhadi, A. (2016). "You Only Look Once: Unified, Real-Time Object Detection." *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*.
- Zhou, Z., Sohn, S., & Peng, Y. (2021). "Real-Time Edge AI for Industrial Quality Inspection." *IEEE Internet of Things Journal*, 8(9), 7012-7024.
- ISO 9001:2015 Quality Management Systems – Requirements.
- Goodfellow, I., Bengio, Y., & Courville, A. (2016). "Deep Learning." *MIT Press*.
- Nguyen, H., Valiveti, S., and Ramachandran, S. (2020). "AI in Quality Control: Industrial Applications and Case Studies." *Journal of Manufacturing Systems*, 57, 366-380.
- Regattieri, A., Gamberi, M., & Manzini, R. (2007). "Traceability of Food Products: General Framework and Experimental Evidence." *Journal of Food Engineering*.