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AI Based Product Detection and Sorting

Prof. Akhtar .I[1], Kadam Chaitanya[2], Maniyar Tayyab[3], Joshi Harsh[4], Kasar Sham[5]
Guide, Department of Computer Engineering[1]
Students, Department of Computer Engineering[2,3,4,5]
SND College of Engineering & Research Center, Yeola, Maharashtra, India

Abstract: *Fruits and vegetables (especially, tomatoes) healthy detection are important tasks for smart agriculture. Several works have been published in tomato detection, however, there is little research on using explainable AI to detect, classify and count tomato fruit status. In this work, we propose a Tomatoes Health Check System by evaluating MobileNet models based on the physiological tomato dataset. Our research conducts experiments to evaluate the accuracy of the MobileNets, MobileNetV2 and MobileNetV3 models based on the evaluation metrics; the highest accuracy of 96.69proposed method we suggest is to utilize Grad-CAM++ for a visual explanation of predictions made by models belonging to the MobileNets family. Subsequently, we calculate Intersection over Union metrics at various thresholds (0reliability, Grad-CAM++ is used to explain and evaluate reliability, with MobileNetV2 achieving the highest values at 100.00YOLOv8 and MobileNetV2 algorithms using the Simple Online and Real-time Tracking (SORT) algorithm to detect, classify, and count tomatoes based on physiological characteristics in videos. Finally, the research results are utilized to develop an application system.*

Keywords: AI Based Sorting, Product Detection, AI Classification, Real Time Product Detection, YOLO Algorithm, CNN Algorithm

I. INTRODUCTION

Overview Product Detection: Computer Vision: Uses cameras and image processing algorithms to identify products in real-time. This can involve object detection models (like YOLO or Faster R-CNN) trained on specific product datasets. Barcode and QR Code Scanning: Integrates traditional methods with AI to quickly identify products and track inventory. Sorting Mechanisms: Automated Sorting Systems: Utilize conveyor belts and robotic arms to sort products based on predefined criteria (size, type, destination). Machine Learning Algorithms: These can improve sorting accuracy over time by learning from data patterns and feedback.

Motivation Efficiency Improvement: Speed: Traditional sorting methods can be slow and labor-intensive. Automating these processes significantly increases throughput and reduces processing time. Scalability: As businesses grow, so do their operational demands. An AI-based system can easily scale to handle increased volumes without a proportional increase in labor costs.

Cost Reduction: Labor Costs: Automating product detection and sorting minimizes the need for manual labor, reducing operational costs. Error Reduction: Improved accuracy in product sorting decreases the likelihood of costly mistakes, such as mislabeling or shipping errors. Enhanced Accuracy: Precision: AI systems can detect and sort products with a high level of accuracy, reducing human error and ensuring that products are handled correctly. Real-time Data Processing: Instantaneous analysis allows for quick adjustments and corrections, improving overall inventory management.

II. OBJECTIVE

Develop a Robust Detection Model: The objectives of an AI-based product detection and sorting project can be structured to align with its overall goals of efficiency, accuracy, and scalability. Here are some key objectives:

1. Enhance Detection Accuracy Develop and implement advanced computer vision algorithms to achieve a high detection accuracy rate for various product types and categories.
2. Automate Sorting Processes Design and deploy automated sorting mechanisms that can efficiently sort products based on specific criteria (size, type, destination) with minimal human intervention.

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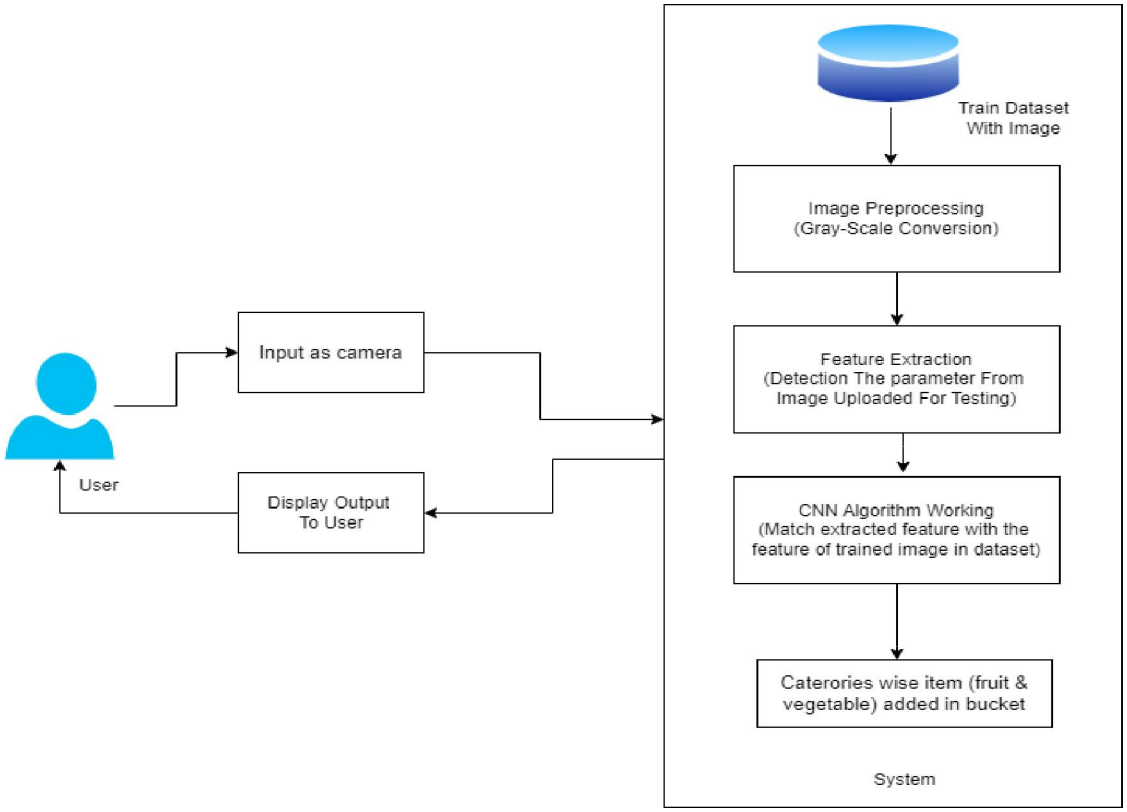
3. Increase Operational Efficiency Reduce sorting and processing time by implementing AI systems that streamline operations, ultimately improving throughput in warehouses and fulfilment centers.
4. Reduce Operational Costs Lower labor and error-related costs by minimizing the reliance on manual sorting processes and enhancing overall system efficiency. 5. Integrate Real-Time Data Processing Ensure the system can process data in real-time, allowing for immediate adjustments and updates to inventory management practices.

III. SYSTEM ARCHITECTURE AND PROPOSED SYSTEM

System Architecture:



Algorithm:

- Data Preprocessing: Collection of product images, labeling, and augmentation.
- Model Training: Using CNN (Convolutional Neural Network) or YOLO (You Only Look Once) for real-time object detection.
- Classification: Products are classified based on predefined features such as shape, size, or labels.
- Sorting: Automated sorting based on classification results using robotic arms or conveyors.

Data Flow Diagram:

In Data Flow Diagram, we Show that flow of data in our system in DFD0 we show that base DFD in which rectangle present input as well as output and circle show our system, In DFD1 we show actual input and actual output of system input of our system is text or image and output is rumour detected likewise in DFD 2 we present operation of user as well as admin.

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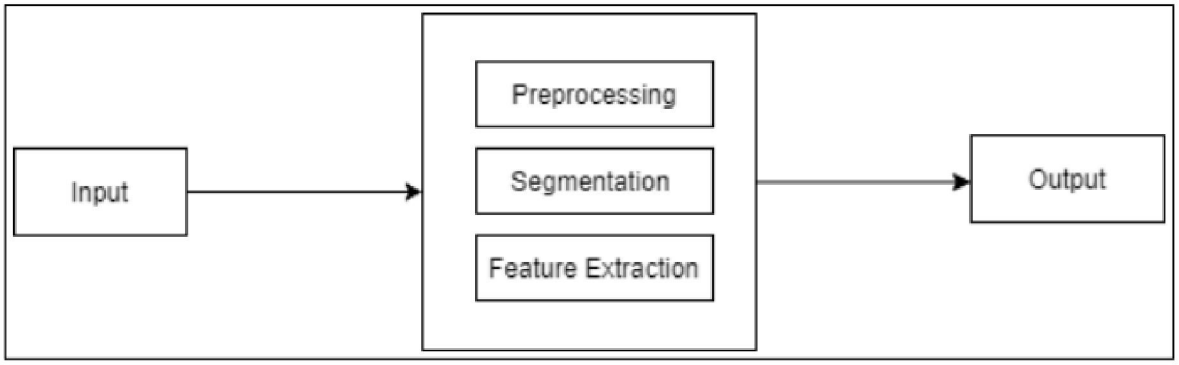
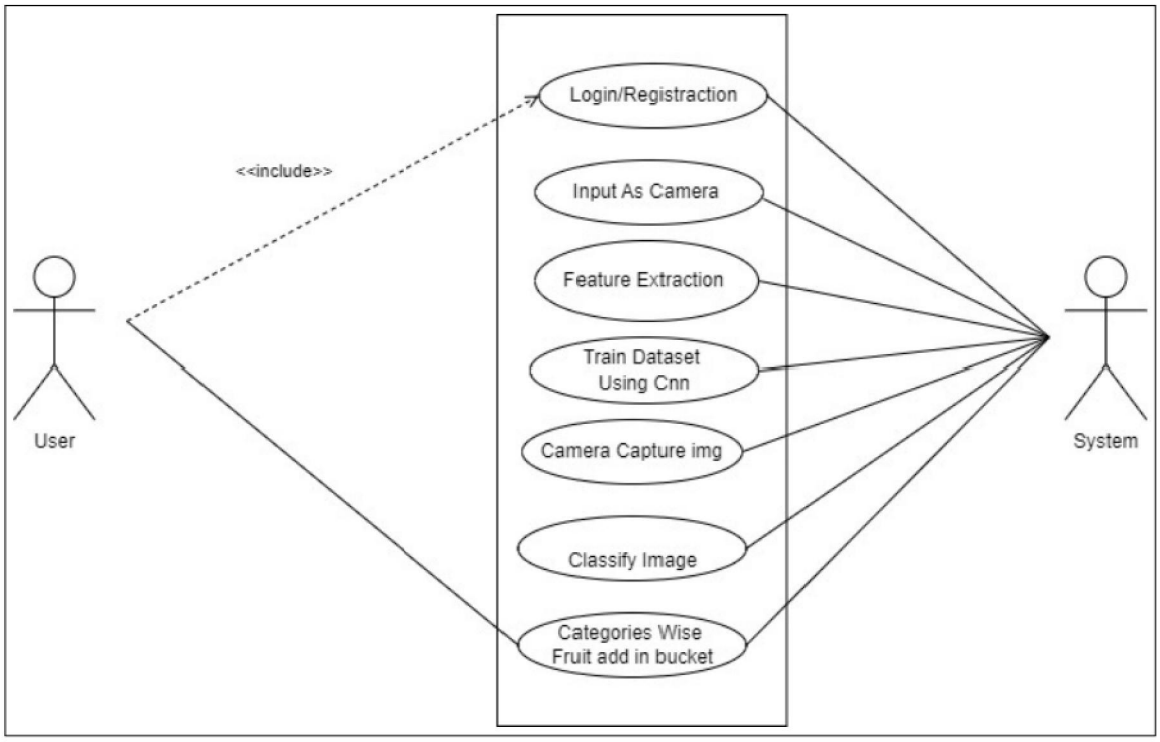


Fig. Data Flow Diagram

UML DIAGRAMS:

Unified Modelling Language is a standard language for writing software blueprints. The UML may be used to visualize, specify, construct and document the artifacts of a software intensive system.UML is process independent, although optimally it should be used in process that is use case driven, architecture-centric, iterative, and incremental. The Number of UML Diagram is available.



IV. ADVANTAGES, LIMITATION& APPLICATION

Advantages:

- Increased Efficiency Speed: AI systems can process and sort products much faster than manual methods, significantly reducing time taken for order fulfillment and inventory management. Continuous Operation: Automated systems can operate 24/7 without breaks, maximizing throughput and productivity.

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- Enhanced Accuracy Improved Detection Rates: Advanced computer vision techniques allow for higher accuracy in product identification, minimizing errors in sorting and inventory tracking. Reduced Manual Errors: Automation decreases the likelihood of human errors associated with manual sorting and data entry.
- Cost Savings Labor Reduction: By minimizing the need for manual labor, businesses can reduce staffing costs and allocate resources more effectively.
- Operational Cost Efficiency: Faster processing and sorting lead to reduced operational costs associated with delays and inefficiencies.

Limitation:

- Initial Investment Costs High Setup Costs: The initial investment for AI technologies, hardware, and system integration can be substantial, which may be a barrier for smaller businesses. Ongoing Maintenance Costs: Regular maintenance and updates to the system can incur additional expenses over time.
- Complexity of Implementation Integration Challenges: Integrating AI systems with existing warehouse management and operational systems can be complex and time-consuming, requiring specialized expertise. Customization Needs: Each business may require tailored solutions, leading to longer development and deployment times.

Application:

- Order Fulfillment Centers: Automated sorting systems streamline the process of picking and packing orders, increasing efficiency and reducing delivery times.
- Inventory Management: AI systems monitor stock levels in real-time, helping retailers maintain optimal inventory and reduce stockouts or overstock situations.

V. CONCLUSION

The automatic classification on the pests of fruit fly has long been a widespread focus among the insiders. Based on the insufficiency of the traditional fruit fly classification system, this paper proposes the convolutional neural network algorithm that can automatically extract features to establish the classification model of the fruit fly, and the test accuracy rate was as high as 97.19automatically extract the features of the fruit fly pests for effective classification, and solve the classification caused by the manual design features in the traditional classification method. The cumbersome and complicated process of classification of fruit flies is simplified, and the work efficiency of quarantine personnel is improved. So, the model has a good application prospect. At the same time, the next goal is to classify fruit flies of complex background, such as natural background, multi-object background, and similar color background, and so on. it difficulty lies in how to separate similar colors and other objects from fruit fly image and effectively extract the features of fruit fly for classification. The traditional feature extraction method may be able to extract fruit fly characteristics from similar colors or multiple objects, but the problems mentioned in the abstract still exist. Therefore, this model has the advantage of automatic feature extraction and can provide an effective reference for fruit fly classification under complex natural background.

VI. ACKNOWLEDGMENT

It gives us great pleasure in presenting the preliminary project report on ‘AI BASED PRODUCT DETECTION AND SORTING’. I would like to take this opportunity to thank my internal guide Prof. Guide Name for giving me all the help and guidance I needed. I am really grateful to them for their kind support. Their valuable suggestions were very helpful. I am also grateful to Prof. HOD Name, Head of Computer Engineering Department, CollegeName for his indispensable support, suggestions. In the end our special thanks to Other Person Name for providing various resources such as laboratory with all needed software platforms, continuous Internet connection, for Our Project.

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