

# Vision Sort

AUTOMETED COUNTING AND SORTING USING IMAGE SEGMENTATION & GENERATIVE AI

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**Abstract – VISION SORT is an intelligent automation system designed for accurate object counting and sorting using image segmentation and Generative Artificial Intelligence (AI). The system addresses limitations of traditional manual and sensor-based sorting techniques, such as low accuracy, high labor dependency, and limited adaptability. By leveraging computer vision techniques, segmented image analysis, and AI-based decision-making, the system can identify, classify, count, and sort objects in real time. Image segmentation is used to isolate individual objects from captured images, while Generative AI enhances robustness by learning variations in shape, size, color, and orientation. The proposed system improves efficiency, scalability, and precision in industrial and agricultural sorting applications. Experimental analysis demonstrates improved accuracy, reduced processing time, and minimal human intervention compared to conventional systems.**

**Key Words: Image Segmentation, Computer Vision, Generative AI, Automated Sorting, Object Counting, Smart Automation**

## I. INTRODUCTION

Automation in industrial and agricultural processes has become essential due to increasing demand for speed, accuracy, and cost efficiency. Traditional counting and sorting systems rely heavily on manual labor or basic sensors, which often suffer from inaccuracies, fatigue-related errors, and limited flexibility. With advancements in Artificial Intelligence and Computer Vision, automated visual inspection systems are increasingly replacing conventional methods.

VISION SORT is an automated counting and sorting system that utilizes image segmentation and

Generative AI to identify and classify objects efficiently. The system captures images using a camera module, processes them using segmentation algorithms to separate individual objects, and applies AI-based classification for sorting. Generative AI enables the system to generalize better across unseen object variations, improving adaptability in real-world conditions. This system is particularly useful in applications such as manufacturing quality control, agricultural produce grading, packaging industries, and warehouse automation. By minimizing human intervention and maximizing accuracy, VISION SORT provides a scalable and intelligent solution.

## II. LITERATURE SURVEY

1. Image Segmentation Techniques for Object Detection – Research by Gonzalez et al. (2020) highlighted the effectiveness of thresholding, edge detection, and region-based segmentation for separating objects in industrial images.
2. AI-Based Object Classification Systems – A study by Sharma & Verma (2021) demonstrated how deep learning models outperform traditional classifiers in object recognition tasks.
3. Automated Sorting Systems in Manufacturing – Research by Lee et al. (2019) discussed the integration of vision systems in conveyor-based sorting mechanisms, showing significant accuracy improvements.

4. Role of Generative AI in Computer Vision – Brown & Patel (2022) explored how Generative AI improves data augmentation and robustness in vision-based systems.
5. Real-Time Vision Processing for Industrial Automation – Thompson et al. (2021) emphasized the importance of real-time image processing for high-speed industrial environments.

#### Objectives-

1. Automate object counting using image segmentation techniques.
2. Implement intelligent sorting based on visual features.
3. Reduce human dependency and manual errors.
4. Improve accuracy and processing speed using AI models
5. Enhance system adaptability using Generative AI.
6. Develop a scalable and cost-effective automation solution.

### III. SYSTEM ARCHITECTURE AND METHODOLOGY

#### System Development

The Vision Sort system is built using a web-based approach:

- Frontend: The Vision Sort system is built using a web-based approach.
- Backend: Python and Flask (or Django) with MySQL/SQLite for database management and handling business logic.

Admin panel: Provides system managers control over dataset management, monitoring processed images, reviewing counting results, and adjusting sorting rules.

#### Workflow

- Image Capture – Objects are captured as they move on a conveyor.
- Pre-processing – Images are cleaned and normalized.
- Segmentation – Objects are isolated using segmentation algorithms.
- Classification – AI model identifies object category.
- Counting – Objects are counted automatically.
- Sorting – Objects are directed to appropriate bins.

#### Security Measures

- User Authentication: Secure login and authentication mechanisms prevent unauthorized access to the system.
- Data Protection: All uploaded images and generated data are stored securely in the database, with proper access controls to prevent unauthorized access or modification.
- Access Control: Admin and user roles are clearly defined, ensuring that only authorized personnel can manage system operations or modify sorting parameters.

#### Scalability & Future Enhancements

- Modular Architecture: New counting algorithms, sorting rules, or AI models can be added easily.
- Cloud & Database Scalability: Supports large-scale image processing and growing datasets efficiently.
- Advanced AI Integration: Future improvements include more accurate image segmentation, real-time processing, and multi-format support.

#### Existing System - Problem Definition

Traditional sorting systems depend on manual labor or Basic sensors. These systems:

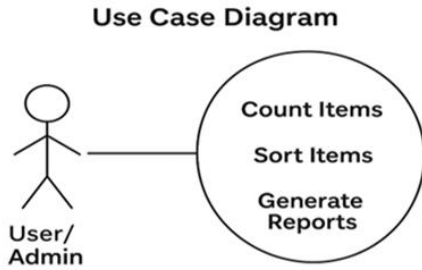
- Are prone to human error.
- Have limited accuracy for complex objects.
- Cannot adapt easily to new object types.
- Require frequent maintenance and recalibration.

#### Proposed System

1. Automated Image Acquisition: The system accepts images from cameras or uploaded image files.
2. Image Preprocessing: Input images are enhanced using resizing, noise reduction, and normalization.
3. Image Segmentation: Advanced image segmentation techniques are applied to identify individual objects.
4. Automated Counting Mechanism: The segmented objects are automatically counted without manual intervention.

- Generative AI–Based Sorting: Generative AI models classify and sort objects based on size, shape, or category.
- Result Visualization and Management: Final results such as object count and sorting categories are displayed to the user.

Use Case Diagram



System design

This system has 5 modules:

- User Module
- Image Processing Module
- Counting Module
- Sorting Module
- Admin Module

User Module

- User registration and login
- Image upload and processing request
- View counting and sorting results history

Image Processing Module

- Image preprocessing (resizing, noise removal)
- Image segmentation for object detection
- Feature extraction from segmented objects

Counting Module

- Automated object counting
- Accuracy validation of counted objects

Sorting Module

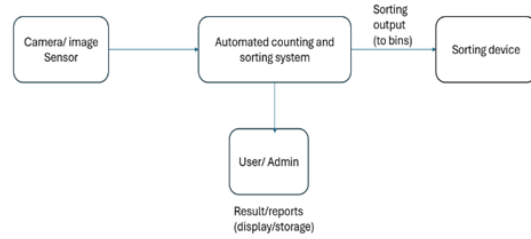
- Intelligent object classification
- Sorting based on size, shape, or category

Admin Module

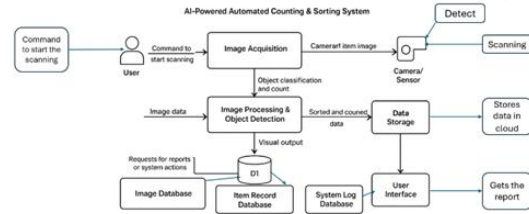
- Manage datasets and AI mode

DFD Diagram

Level – 0

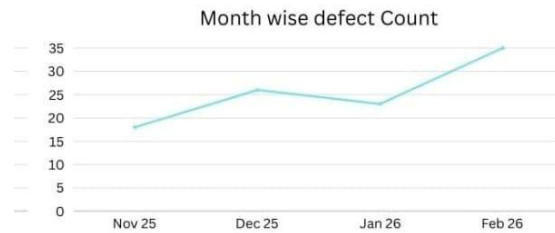


Level - 1



Analysis

Lets, assume the following data for analysis:



1. Chart Overview

The image represents a line chart titled “Month wise Defect Count”, showing how the number of defects changes over time across four months.

- X-axis : Time in months
- Y-axis : Number of defects
- DATA :
  - Nov 25: ~18 defects
  - Dec 25: ~26 defects
  - Jan 26: ~23 defects
  - Feb 26: ~35 defects

Insight:

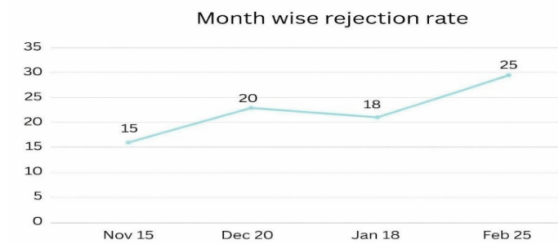
- From November to December, defects increase significantly, indicating a deterioration in quality or process control.
- From December to January, there is a slight decrease, suggesting temporary improvement or corrective action.

Significance:

- The increasing defect trend highlights a need for root cause analysis.
- This data is important for quality control, decision-making, and preventive maintenance planning.

Analysis

Lets, assume the following data for analysis:



### 1. Chart Overview

The image represents a line chart titled “Month wise rejection rate”, showing how the rejection rate varies over time across four months.

- X-axis: Time in months
- Y-axis: Rejection rate (%)
- DATA:
  - Nov 15: ~15%
  - Dec 20: ~20%
  - Jan 18: ~18%
  - Feb 25: ~25%

Insight:

- From November to December, the rejection rate increases noticeably, indicating a decline in process efficiency or quality control.
- From December to January, there is a slight reduction, suggesting that corrective actions or temporary improvements were effective.

Significance:

- The overall upward trend in rejection rate is a warning sign and highlights the need for detailed root cause analysis.
- This data is crucial for quality improvement initiatives, process optimization, and preventive maintenance planning

## 4. DISCUSSION

The Vision Sort system demonstrates how image segmentation combined with generative AI can effectively automate the counting and sorting of objects with minimal human intervention. Traditional manual counting methods are time-consuming and prone to errors, whereas the proposed system significantly improves accuracy and efficiency.

Image preprocessing and segmentation play a crucial role in separating objects from the background, enabling precise detection and counting. The integration of generative AI enhances the system’s ability to classify and sort objects intelligently based on learned features such as shape, size, and category. This makes the system adaptable to different use cases and varying object types.

The modular system design ensures flexibility, allowing future upgrades such as real-time processing, improved AI models, and integration with automated machinery. While the system performs efficiently under controlled conditions, challenges such as varying lighting conditions, complex backgrounds, and overlapping objects remain areas for improvement.

## 5. CONCLUSION

The Vision Sort project successfully demonstrates an automated approach to object counting and sorting using image segmentation and generative AI techniques. The system reduces manual effort and human error by providing accurate, efficient, and intelligent analysis of images

By combining preprocessing, segmentation, automated counting, and AI-based sorting, the proposed system offers a reliable solution for real-world applications such as manufacturing, agriculture, and quality inspection. The modular design allows easy scalability and future enhancements, including real-time processing and integration with automated systems.

Overall, Vision Sort proves to be an effective, flexible, and future-ready vision-based system.

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