SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)
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COIMBATORE-641 035, TAMIL NADU

1. Introduction

An **Electronic Color Sorter**, also known as a **Color Sorting Machine** or **Optical Sorter**, is a high-tech device used to separate items based on color differences. It uses optical sensors and cameras to inspect materials and automatically sort them based on predefined color parameters. These machines are extensively used in the **food processing industry** (e.g., rice, pulses, grains, tea, nuts), **recycling**, and **mineral processing**.

2. Concept and Working Principle

Concept:

The fundamental concept of an electronic color sorter is to detect and remove items that differ in color from a defined standard. This enhances the quality, purity, and commercial value of the final product.

Working Principle:

Feeding: The raw product is fed into the machine through a hopper.

Spreading: Vibrating feeders distribute the material into a thin stream along chutes.

Imaging: High-resolution cameras or sensors scan each particle as it falls.

Analysis: An onboard computer analyzes the color of each item.

Ejection: If a particle's color does not match the programmed acceptable range, an air jet is activated to blow the item into a separate rejection bin.

Collection: Sorted (accepted) items are collected in a separate bin.

3. Major Components

1. Feeding System

Includes **hopper**, **vibrating feeder**, and **chutes** to control the flow and position of particles for accurate scanning.

2. Optical System

High-resolution cameras or **CCD/CMOS sensors** (often RGB or full-spectrum).

Detect color, shape, size, and sometimes transparency.

May also include **infrared** or **NIR** sensors for more advanced sorting.

3. Lighting System

Provides uniform, bright, and high-intensity light to illuminate particles.

Types include **LED**, **halogen**, or **infrared lights**, depending on the application.

4. Image Processing Unit (CPU)

A high-speed **microprocessor** or **FPGA** compares each particle's color to preset standards.

Makes rapid decisions for real-time sorting.

5. Ejection System

Pneumatic nozzles or **air jets** eject defective or unwanted particles in milliseconds.

Precise actuation ensures correct particles are removed without disrupting the rest.

6. User Interface

Touchscreen panel or computer interface allows the user to set sorting parameters and monitor performance.

Stores recipes for different products.

4. Types of Electronic Color Sorters

1. Belt-Type Color Sorter

Material moves on a belt.

Suitable for fragile materials (e.g., dried fruits) as it reduces impact damage.

2. Chute-Type Color Sorter

Material slides down a chute.

Faster and used for free-flowing granular products like rice or grains.

3. RGB/Full-Color Sorters

Use full-spectrum RGB cameras.

Can distinguish between fine color shades.

4. Infrared (IR) and NIR Sorters

Can sort based on material composition and not just color (e.g., plastic types, foreign matter).

5. Multi-functional Sorters

Combine multiple technologies: color, shape, size, and even chemical properties (with hyperspectral imaging).

5. Applications

Food Industry

Rice and grain sorting: Remove discolored, damaged, or foreign kernels.

Tea and coffee: Separate unwanted leaves or beans.

Pulses and lentils: Remove split, broken, or discolored grains.

Nuts and seeds: Remove rotten or infected ones.

Plastic and Recycling

Separate colored plastic flakes or metal pieces from plastics.

Minerals

Distinguish between valuable ores and gangue material.

Agricultural Produce

Used for sorting fruits and vegetables based on ripeness, defects, or blemishes.

6. Advantages of Electronic Color Sorters

Advantage	Description
High Accuracy	Sorts products with color differences that are not visible to the human eye.
High Speed	Can process tons of material per hour with real-time decisions.
Reduces Human Error	Consistent quality output without fatigue or subjective judgment.
Cost-Efficient	Reduces labor cost and improves productivity in the long run.
Improves Product Quality	Enhances visual appeal and market value of the final product.
Minimizes Waste	Ensures maximum usable product is retained and only defective ones are rejected.
Customizable	Parameters can be set and changed easily for different materials.

7. Limitations

High Initial Cost: Expensive equipment with advanced optics and computing.

Maintenance Requirements: Needs regular cleaning, calibration, and servicing.

Training Needed: Operators require technical knowledge to set and monitor the system.

May Miss Non-Color Defects: Cannot detect internal defects or contaminants that are not visible.

Air Jet Wear and Tear: Frequent use can wear out ejection systems.

8. Recent Developments

AI and Deep Learning Integration: Enables better detection and classification of defects.

Cloud Connectivity and IoT: Real-time data tracking, analytics, and remote monitoring.

Hyperspectral Imaging: Goes beyond color to assess chemical composition.

Multi-camera Systems: Provide 360-degree view and enhance accuracy.

Conclusion

Electronic color sorters are essential for modern industries aiming for high efficiency, safety, and product quality. Their ability to sort materials based on color, shape, and composition makes them indispensable in agriculture, food processing, and recycling. As technology advances, the integration of AI, hyperspectral imaging, and automation is pushing the capabilities of color sorters to new heights.