



# PARCEL SINGULATOR SYSTEM

Multi-Belt Parcel Singulator Conveyor System



MAKE IN INDIA



MT-MKT-API-01, V1.2



## Parcel Singulator System

**Muvro's Multibelt Parcel Singulator System** is a next-generation solution for accurate recognition and adaptive singulation, designed to transform bulk flows of mixed or overlapped parcels into a smooth, single-file, evenly spaced stream.

Breaking away from traditional 3D bulk flow handling methods, this intelligent system leverages advanced AI-powered vision technology and a high-performance embedded processing platform to deliver precise, real-time singulation in fast-paced logistics environments. At its core is a 3D Vision Camera integrated with real-time object detection, stereo depth sensing, and machine learning algorithms—enabling the system to detect, segment, and align multiple parcels simultaneously, even in stacked or overlapping conditions. The result is a seamless, collision-free infeed, optimized for high-efficiency sorting and scanning operations.

### System Overview

An AI-driven detection engine powered by a customized YOLO-based parcel recognition algorithm enables fast and accurate identification of parcels in high-throughput logistics environments. Advanced edge segmentation, using OTSU thresholding and edge fusion, sharpens parcel boundaries, while second-order edge detection improves the separation of stacked items. With multi-area positioning and intelligent volume control across infeed sections, the system ensures precise, consistent singulation of varied parcel types and sizes.

A modular array of independently driven narrow belts, arranged in rows and columns, forms the core of the singulation conveyor. Each belt operates at adjustable speeds and directions, allowing real-time dynamic control. By modulating belt speed and timing, the system separates, aligns, and centres irregularly oriented parcels into a uniform, single-lane flow—optimized for downstream sorting and scanning.

## Key Features



### AI-Powered Detection

YOLO + OTSU algorithms for fast, multi-parcel recognition



### Real-Time 3D Vision

High-accuracy 3D Vision Camera with stereo depth sensing up to 20 m



### High Singulation Accuracy

99% success rate for mixed & stacked parcels



### Parcel Flexibility

Handles sizes from 150×150×1 mm up to 600×700 ×500 mm (larger on request)



### Modular Belt System

30–48 belts with dynamic speed/direction control.



### High Throughput

3,000–10,000 parcels/hour



### Adaptive Flow Control

Auto-adjusts infeed spacing based on vision feedback



### Seamless Integration

Ready for WCS, SCADA & sorter systems

## Working Stages of Parcel Singulation

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#### 1. Bulk Entry

Parcels arrive in a random, overlapped state with varying sizes and orientations.

#### 2. Initial Separation

Speed-differentiated belts begin to spread parcels apart—both side-to-side and front-to-back—breaking up clusters.

#### 3. Singulation & Spacing

Downstream belts apply controlled acceleration and deceleration to create consistent spacing between parcels.

#### 4. Alignment & Centering

Mid-zone belts gently nudge and guide parcels toward the centerline, correcting orientation and position.

#### 5. Final Output

A smooth, single-lane stream of uniformly spaced parcels exits—ready for scanning, weighing, or sorting downstream.



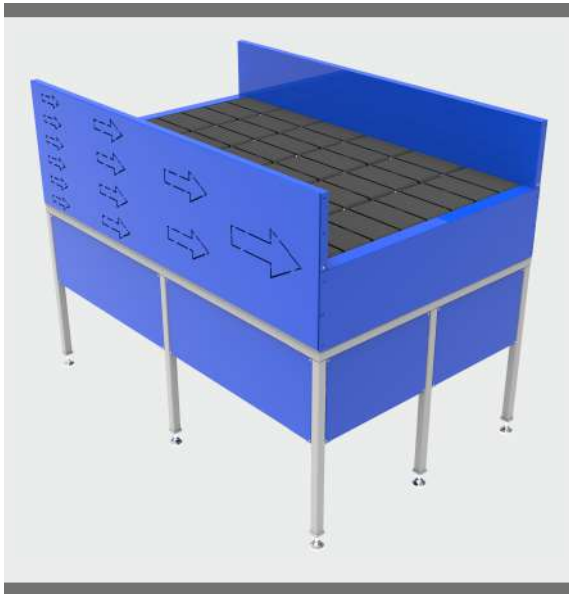
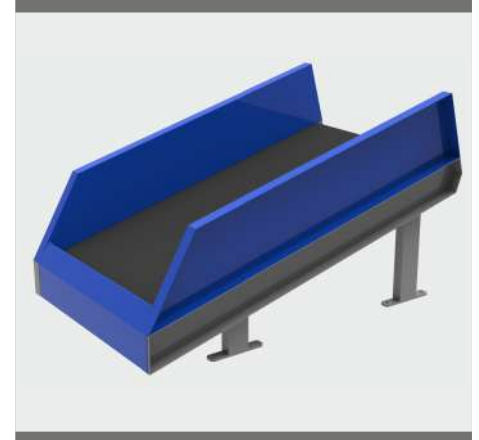
## Key Components

### 3- Infeed Conveyor (Bulk Receiving Conveyor)

The **Infeed Conveyor** comprises a series of **independently driven PVC flat belt modules**, typically 3 to 4 in number, installed at an incline to create a cascading or "waterfall" effect. This design helps convert stacked or disordered parcels (**3D flow**) into a flat, single-layered stream (**2D flow**) for effective downstream singulation.

As parcels drop from one belt to the next (~300 mm height), the impact and directional motion naturally separate overlapped or stacked items. Each subsequent belt pulls parcels forward, further enhancing separation and alignment.

Integrated variable speed and stop/start control allows real-time spacing adjustments. A **2D vision camera**, mounted above, continuously monitors parcel density. Using smart algorithms, the controller dynamically regulates belt speeds, ensuring smooth, jam-free transfer into the Multi-Belt Singulator—maximizing throughput and consistency.



### 4- Multibelt Segments (Separator / Singulator)

The Multibelt Segments form the core of the singulation system and are designed to dynamically manage parcel flow through intelligent motion control. These segments consist of an array of narrow-width belts, each powered by its own independently controlled motor and drive system. This architecture allows each belt to operate at variable speeds and directions in real time.

By adjusting the speed and timing of individual belts, the system performs critical functions such as:

- Parcel acceleration to create spacing,
- Deceleration to reduce speed for alignment,
- Lateral redirection to centre misaligned parcels.

This flexible control enables the singulator to separate tightly packed or overlapped parcels, correct their orientation, and guide them into a uniform, single-lane output stream. The modular nature of the design also allows for scalability and easy adaptation to different throughput requirements or parcel dimensions.

### Vision Camera

The **3D Vision Camera** is a high-performance industrial imaging solution purpose-built for **parcel singulation** in fast-paced logistics and e-commerce environments. Positioned above the Multibelt Conveyor, it delivers **real-time, high-accuracy detection** of parcel position, orientation, and volume.

Utilizing **stereo vision and structured light technology**, the camera captures detailed 3D data that enables the control system to dynamically adjust belt speeds and directions—ensuring optimal alignment, spacing, and smooth flow. This significantly improves singulation efficiency, reduces parcel jams, and enhances barcode scanning and sorter performance downstream.

Designed for seamless integration, the system supports **GigE and Ethernet interfaces** and is backed by robust software tools for configuration and analytics.



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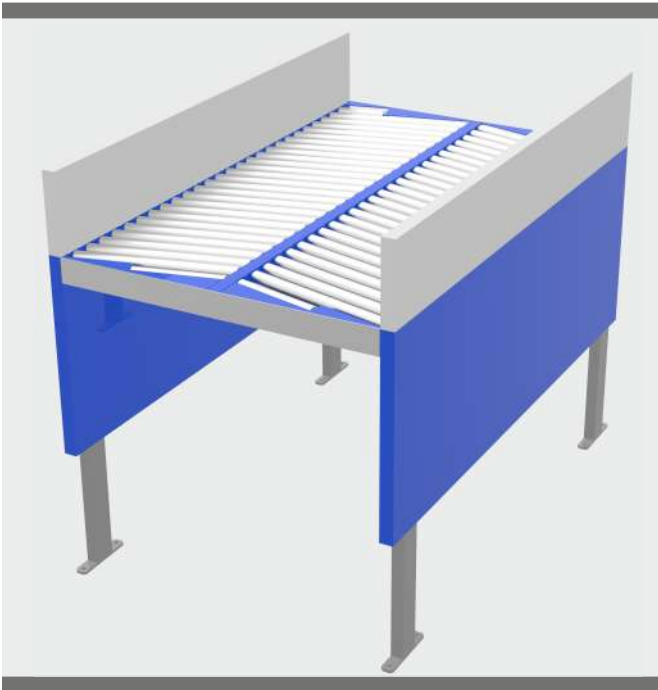
## Control System

The singulator is managed by a PLC or PC-based control system equipped with advanced algorithms that dynamically adjust each belt's speed and direction to align and space parcels into a uniform, collision-free stream.

It supports two operating modes:

- **Variable Speed Mode** for precise control in 0.1 m/s increments, ideal for fine-tuning based on parcel flow conditions.
- **Start/Stop Mode**, where modules alternate between idle and default speeds automatically, ensuring smooth flow with minimal manual input.

This **adaptive control logic** allows the system to respond in real time to parcel volume changes, ensuring consistent singulation performance across varying throughput scenarios.

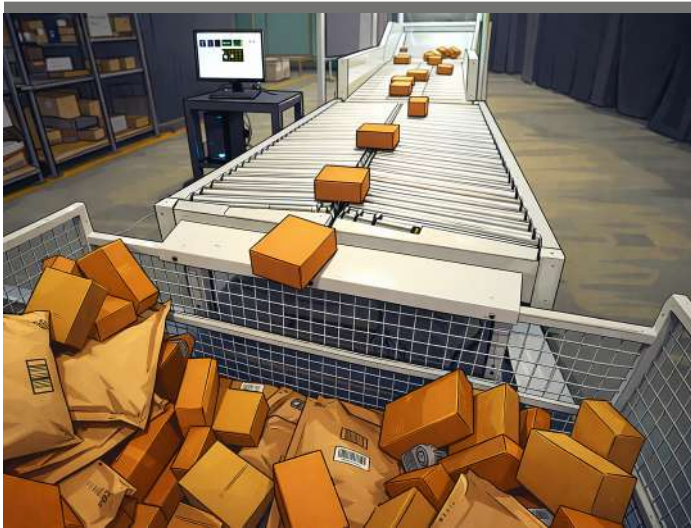


## 5- Discharge Conveyor

→ Roller Conveyor → | → Centerline →

The **Discharge Conveyor** features a **Herringbone Roller layout** with angled rollers that create a natural **self-centering effect**, smoothly guiding parcels toward the centerline for precise handoff to downstream systems.

Driven by **flat belts** and an **AC geared motor with VFD**, the rollers rotate consistently through controlled friction, aided by **under-mounted pressure rollers**. This setup ensures accurate alignment, reduces jams, and supports **high-speed discharge**, making it ideal for logistics, courier, and e-commerce operations.



## Applications



### Parcel Hubs & Courier Services

For automated parcel induction and singulation at large-volume distribution hubs.



### E-commerce Fulfilment Centres

Ensures efficient flow from inbound to sorting in fast-paced online retail warehouses.



### E-commerce Sort Centres

Optimizes parcel spacing and alignment before high-speed sorters.



### Postal Services

Enhances throughput and accuracy for national and regional mail facilities.



### Third-Party Logistics (3PL) Facilities

Supports diverse parcel handling for multi-client warehouse operations.

## Technical Specifications Vision System

| Parameter             | Specification                                                           |
|-----------------------|-------------------------------------------------------------------------|
| Technology            | Stereo Vision                                                           |
| Use Environment       | Indoor & Outdoor                                                        |
| Working Range         | 0.25 m to 20+ m                                                         |
| Ideal Range           | 0.25 m to 6 m                                                           |
| Depth Resolution      | Up to 1280 × 800 @ 30 fps                                               |
| Depth Accuracy        | ≤ 0.8% @ 2 m, ≤ 1.6% @ 4 m                                              |
| Field of View (Depth) | 90° × 65° ±3° @ 2 m                                                     |
| Depth Filter          | Visible + NIR-Pass                                                      |
| RGB Sensor            | Global Shutter, Up to 1280 × 800 @ 60 fps                               |
| RGB FOV Options       | 94° × 68° (16:10), 94° × 62° (16:9), 82° × 66° (4:3)                    |
| IMU                   | 6DoF (Gyroscope + Accelerometer, 50–1000 Hz)                            |
| Depth Processing      | Onboard ASIC (Orbbec MX6800)                                            |
| Data Interface        | Gigabit Ethernet, POE Supported                                         |
| Power Supply          | POE (IEEE 802.3af) or DC (9V–24V, ≥1A)                                  |
| Power Consumption     | < 5.0 W average                                                         |
| Operating Temperature | –10°C to 50°C                                                           |
| Protection Rating     | IP67                                                                    |
| Supported Features    | Hardware Depth-to-Color Alignment, Multi-Camera Sync, PTP Timing, RS485 |
| Mounting Options      | Back: 2 × M4; Bottom: 4 × M4 or 1 × 1/4"–20 UNC                         |
| Dimensions            | 124 mm × 29 mm × 50 mm                                                  |
| Weight                | 220 g ± 3 g                                                             |

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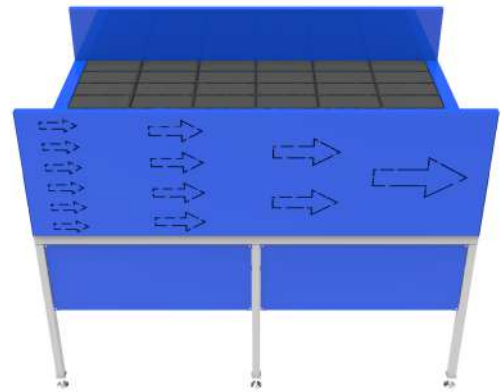
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