ErmaSmart #5

Dynamic Vertical Store

Dynamic storage and retrieval system for trays or boxes/pallets

Description of the system

The **Dynamic Vertical Warehouse** system is an **automated customer order picking system.** It ensures the dynamic storage and retrieval of trays or boxes/pallets. In order to prepare an order, it can combine stored trays or boxes/pallets with just-in-time produced trays or boxes/pallets. It thus allows to approach the notions of stock, minimum production quantity, just-in-time...

It incorporates a **system of 2 XZ Cartesian axes, which are** often used in industrial vertical warehouses. The functions and components are based on real industrial components used in the logistics industry.

This **Dynamic Vertical Warehouse** system (ref **VL10**) designed in the spirit of **the industry of the future** (Industry 4.0) meets the main requirements on intelligence and the evolution of production methods:

- ✓ **Flexibility & customisation** with the possibility of unvidual order picking
- ✓ **IoT & Communications** with RFID tag reading/writing for identification and tracking of customer order packages.

This **automated** system can be **used independently** with trays or boxes/pallets, but can also be **integrated into the flexible ErmaSmart production line (see p. 3 and 4)**.

The main functions of the Dynamic Vertical Store (VL10) are:

- ✓ **Convey** the trays or boxes/pallets from the infeed to the pick-up station, and possibly let them go to the conveyor outfeed in case of just-in-time production
- ✓ **Place** the trays or boxes/pallets in the indicated vertical shop location by associating the RFID number of the trays or boxes/pallets with the product type and the storage location in the shop
- ✓ **Retrieve** trays or boxes/pallets from the registered bins to prepare an order with stock, checking that the RFID number of the tray or box/pallet entered is the one requested
- ✓ **Remove** trays or boxes/pallets to the exit

This training system is mainly intended for **activities in the fields of operation, system control, industrial maintenance, electrical engineering, automation and mechanics**.

This product is accompanied by a technical and educational file in digital format.

CAP CIP - Bac PRO PLP / MELEC / MSPC
BTS CRSA / Electrical engineering / MS
IUT - Universities - Engineering schools

Main Themes
Industrial Maintenance
Production Control
Multi-technology Systems Design
Electrical Engineering and Automation

Themes "Industry 4.0" addressed

- Scalability & Flexibility
- Customisation
- Simplified programming
- Digital twin
- Mobile Robotics
- Collaborative Robotics
- Efficient Actuators
- CAPM & CMMS
- Digital instructions & MES
- Quality control "online".
- Vision & Smart Sensors
- IOT & Communications
- Big Data, AI & Predictive Maintenance
- Augmented reality
- Virtual reality
- Additive manufacturing for tooling...

Overview

Highlights

- Real **industrial system** with **modern technologies (XZ Cartesian robot, IO-Link, Ethernet, Profinet, RFID...)**
- **Production flexibility** with the storage of different trays and boxes/pallets
- **Traceability of the customer's order** with the writing and reading of RFID tags
- Introduction to **industrial logistics techniques**
- System usable in the fields of **electrical engineering**, **industrial maintenance**, and the **operation and piloting of automated systems**
- Includes Siemens Tia Portal programming software for programming the PLC and the dialogue terminal
- **IO-Link technology** with IO-Link Profinet master (IFM brand) and MONEO Configure sensor visualization and setting software and IO-Link intelligent sensors (RFID, vacuum generator, photoelectric sensor...)
- Possible extensions to the ErmaSmart flexible production line

IO-Link

Didactique | Robotique | Fab&Test | Energies

General

The Dynamic Vertical Store (Ref: VL10) consists mainly of :
- ✓ A welded frame with epoxy paint, fully enclosed on 4 castors with brakes.
- ✓ An electrical cabinet with a man-machine interface (colour touch panel) fixed to the chassis
- ✓ An operating part with three main functional assemblies, the conveyor, the 2-axis XZ Cartesian robot and the gripper system.

Functional sub-assembly "Conveyor

It consists mainly of :
- ✓ A 9 m/min belt conveyor with edges
- ✓ A 230/400V 0.09 kW three-phase asynchronous geared motor controlled by a variable speed drive
- ✓ Two light curtains at the conveyor inlet and outlet
- ✓ A tray or box/pallet arrival station with a presence detector (Station 1) and an IO-Link RFID transceiver to read the information on the RFID tags of the trays or boxes/pallets
- ✓ A tray or box/pallet departure station with presence detector (Station 2) and IO-Link RFID transceiver to read and write information on the RFID tags of the trays or boxes/pallets
- ✓ An evacuation zone

Functional sub-assembly "XZ robot

It consists mainly of :
- ✓ A two-axis XZ Cartesian robot with stepper motors incorporating an encoder, belt drive and greaseless linear guidance. The working area is approximately 1000 x 1600 mm with a load capacity of 20N
- ✓ Limit switches on both axes
- ✓ A suction cup gripping mechanism with energy-saving IO-Link vacuum generator

Functional sub-assembly "Gripping system

It consists mainly of :
- ✓ A proportional pneumatic cylinder with IO-Link position sensor
- ✓ A suction cup gripper system with energy-saving IO-Link vacuum generator
- ✓ An IO-Link distance sensor (with on-board task) to monitor the presence of a tray or box/pallet in a location

Installation features

VL10 :
- ✓ Dimensions (LWD): 2400 x 1100 x 2260 mm
- ✓ Mass: 200 kg
- ✓ Power supply: 230 V three-phase (P + N + T)
- ✓ Pneumatic supply: 7 bar

Electrical control / command cabinet

It consists mainly of :
- ✓ A padlockable disconnect switch
- ✓ A set of electrical protections
- ✓ A safety relay, an emergency stop button and a system reset button
- ✓ A Siemens S7-1200 PLC (or optional S7-1500)
- ✓ A Siemens SIMATIC HMI MTP700 Unified colour touch screen Human Machine Interface
- ✓ A switch to ensure communication between the PLC, the HMI and the connected environments
- ✓ An IO-Link Profinet master (IFM brand) and MONEO Configure sensor visualization and setting software
- ✓ A variable speed drive for the conveyor
- ✓ Two axis control boards for the stepper motors of both XZ axes
- ✓ An area dedicated to the electrical wiring of new components in the context of system improvements (new sensors, actuators, etc.)

Light curtain at the conveyor entrance

IO-Link Master and MONEO Configure visualisation and setting software

Programmable Logic Controller Industrial S7-1200

Human Machine Interface Siemens HMI MTP700 Unified

Dynamic Vertical Store
Station 5 of the ErmaSmart flexible production line "Packaging

ErmaSmart Item 5 "Packaging

In the **ErmaSmart "Packaging"** context, the Dynamic Vertical Store is used for dynamic storage and retrieval of trays, as well as order picking.

Upstream of the Dynamic Vertical Store are:
- Station 1: The **2D Unscrambling & Screwing Robot**, 2D/3D jar/flask unscrambling and conveyor placement system (ref **ON10 and associated codes**)
- Item 2: The **Dosaxe**, automatic linear axis filling system (ref **DX10 and associated codes**)
- Station 3: The **Collaborative Robot Capping & Assembly** system for capping, custom overcapping and control (ref **MI00 and associated codes**)
- Item 4: The **XYZ Cartesian Pick&Place (**ref **XY10 and associated codes**)

Downstream from the Dynamic Vertical Store is:
- Station 6: The **manual order picking, packing and palletising station with RFID tracking** (ref **PM91**).

ErmaSmart Configuration "Conditioning

In the ErmaSmart "Packaging" configuration, the Dynamic Vertical Magazine provides storage and order picking of trays.

This configuration requires the codes:
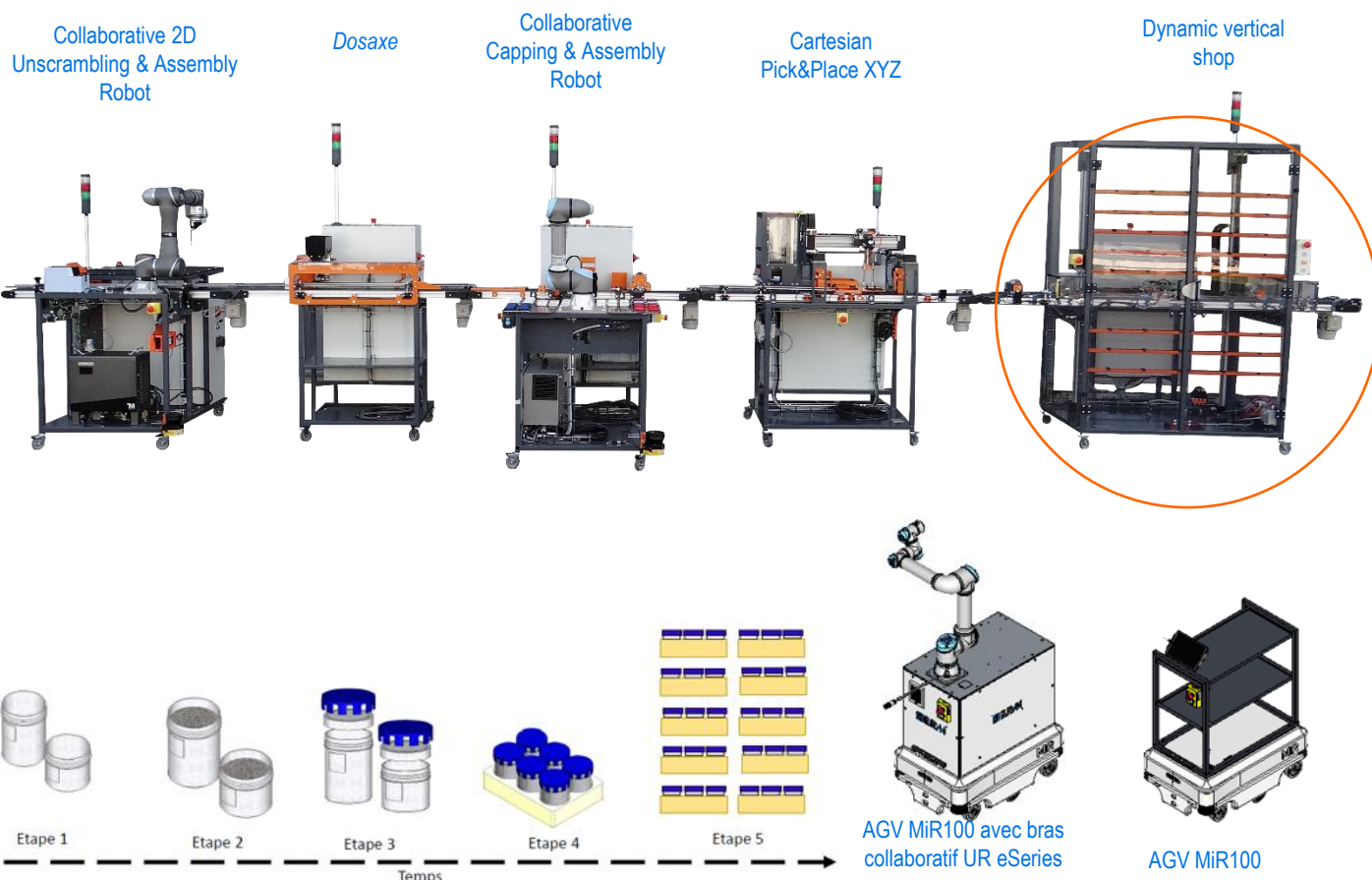- VL10 : Dynamic Vertical Magazine with tray gripping and storage module

Combined operation with AGV(+Arm)

Ermasmart offers the combined use of the Dynamic Vertical Warehouse and the MiR100 AGV with UR eSeries collaborative arm.
These two systems communicate with each other so that the AGV+Arm can autonomously retrieve boxes/tray from an order at the exit of the conveyor or load the Dynamic Vertical Magazine with component boxes (Stand alone version).
If the AGV is not equipped with an arm, an operator will have to perform the handling operations between the AGV and the Dynamic Vertical Warehouse.

Dynamic Vertical Warehouse integrated into the ErmaSmart Industry 4.0 Factory "Packaging

Collaborative 2D Unscrambling & Assembly Robot

Dosaxe

Collaborative Capping & Assembly Robot

Cartesian Pick&Place XYZ

Dynamic vertical shop

Etape 1 Etape 2 Etape 3 Etape 4 Etape 5

Temps

AGV MiR100 avec bras collaboratif UR eSeries

AGV MiR100

ERM AUTOMATISMES
Didactique | Robotique | Fab&Test | Energies

Dynamic Vertical Store
Station 4 of the ErmaSmart flexible production line "Assembly

ErmaSmart Station 5 "Assembly

In the **ErmaSmart "Packaging"** context, the Dynamic Vertical Store is used for dynamic storage and retrieval of trays, as well as order picking.

Upstream of the Dynamic Vertical Store are:
- Item 1: The **XYZ Cartesian Pick&Place** (ref **XY10 and associated codes**)
- Station 2: The **Collaborative Capping & Assembly Robot**, customised assembly system and control (ref **MI00 and associated codes**)
- Station 3: The **2D Unscrambling & Assembly-Screwing collaborative robot**, assembly and screwing system (ref **ON10 and associated codes**)

Downstream from the Dynamic Vertical Store is:
- Station 5: The **manual order picking, packing and palletising station with RFID tracking** (ref **PM91**).

ErmaSmart Configuration "Assembly"

In the ErmaSmart "Assembly" configuration, the Dynamic Vertical Warehouse provides storage and order picking of boxes/pallets.

This configuration requires the codes:
- VL10: Dynamic Vertical Warehouse with box/pallet picking and storage module

Combined operation with AGV(+Arm)

Ermasmart offers the combined use of the Dynamic Vertical Warehouse and the MiR100 AGV with UR eSeries collaborative arm.

These two systems communicate with each other so that the AGV+Arm can autonomously retrieve boxes/tray from an order at the exit of the conveyor or load the Dynamic Vertical Magazine with component boxes (Stand alone version).

If the AGV is not equipped with an arm, an operator will have to perform the handling operations between the AGV and the Dynamic Vertical Warehouse.
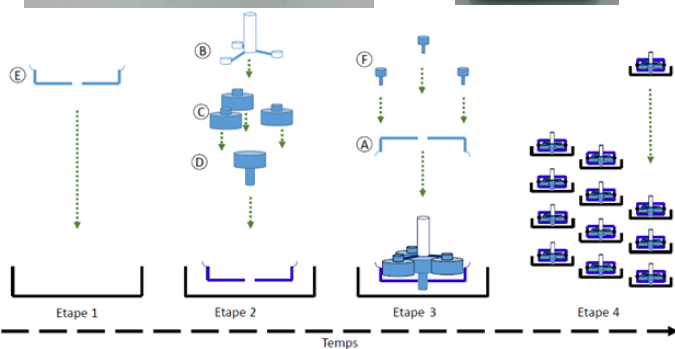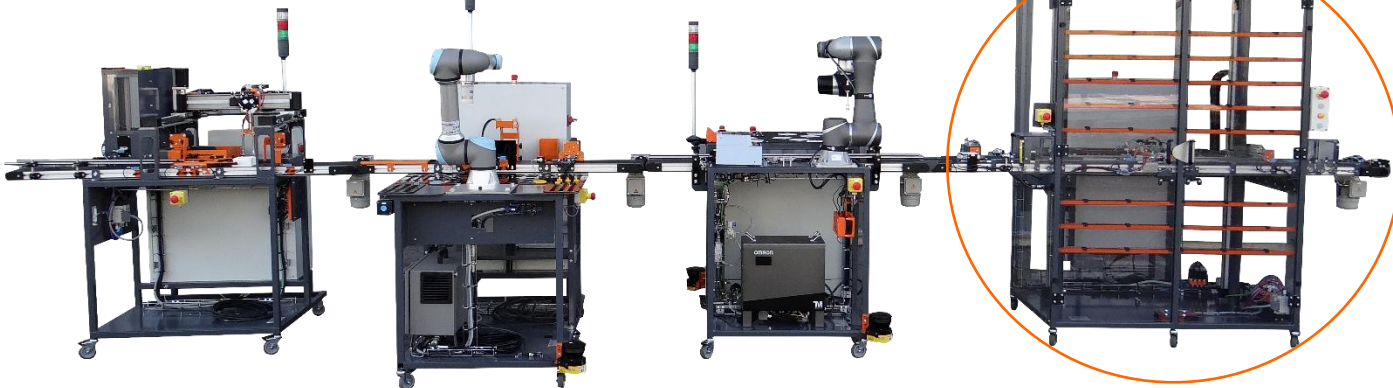
Dynamic Vertical Warehouse integrated into the ErmaSmart Industry 4.0 Factory "Assembly

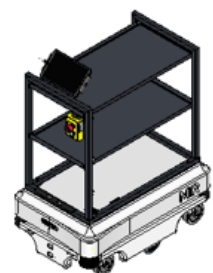Cartesian
Pick&Place XYZ

Collaborative
Capping & Assembly
Robot

Collaborative 2D
Unscrambling & Assembly
Robot

Dynamic vertical
shop

AGV MiR100 with UR
eSeries collaborative arm

AGV MiR100

Etape 1   Etape 2   Etape 3   Etape 4

Temps

Didactique | Robotique | Fab&Test | Energies

Educational activities

The Dynamic Vertical Store system allows the following **educational activities** to be carried out

- ✓ **Electrical engineering**
  - **Discovery and handling of the system (**functional analysis and study of system technologies)
  - **Control of the system's electrical quantities** (network, power supply, drive, XZ axis controls, PLC, HMI and control circuit).
  - **Commissioning and validation of the** system **operation** (of the different production modes)
  - **Adjustment and parameterisation of** the installation components (asynchronous geared motor and its frequency converter, XZ axis control)
  - **Wiring of** new sensors and actuators (improvement and/or replacement of an electrical component of the installation)
  - **Programming of** new cycles of the PLC and the Human Machine Interface (TIA Portal software supplied).
  - **Diagnosis of a malfunction or malfunctions**
  - **Use of digital tools and communication**
- ✓ **Automation**
  - **Functional** and **structural analysis** of the system
  - **Programming the Vertical Magazine Axis Controls**
  - **Programming of production cycles** (TIA Portal software delivered with the system)
  - **Programming** of **the human machine interface** (TIA Portal software delivered with the system)
  - Implementation of IO-Link sensors (Reassignment of inputs/outputs...) and IO-Link vacuum generator
- ✓ **Production control**
  - **Production control** with choice of packaging method (in cartons or trays)
  - **Change of** production **format**
  - **Traceability and logistics with RFID tag writing**
  - **Development of operator support procedures**
  - **Optimising production with digital 4.0 tools**
- ✓ **Industrial maintenance**
  - **Preventive maintenance** (conveyors, suction, etc.)
  - **Corrective maintenance** (fault diagnosis using the TIA PORTAL basic software delivered with the cell, rapid manufacture of 3D printing tools, etc.)
  - **Improved maintenance** (addition of sensors on the conveyor, new format of boxes, trays,...)
- ✓ **Mechanics**
  - Study of a station with linear axes, ergonomics, dimensioning of axes and actuators...
  - Design of 3D printed parts

References

VL10: Dynamic Vertical Magazine with Pick and Place module for trays (ErmaSmart "Packaging"), boxes/pallets (ErmaSmart "Assembly") and standard component boxes (Stand alone version)

UC90 : Option: Fault box for electrical box, remotely configurable on a tablet (Not supplied)

UC51 : Option: Visual instructions & Monitoring of production indicators on the Tulip open application environment and touchscreen tablet, for one machine (with a 3-year subscription to Tulip Pro, €1170 excl. tax per year beyond that)

UC52 : Option: Visual instructions on the Tulip open application environment and touchscreen tablet, for one machine (with a 3-year subscription to Tulip Standard, €570 excl. tax per year beyond that)

UC41: Siemens Remote Desk Option on iPad (Included)

IO01: Option: Electrical and pneumatic measurement sensors (IO-Link) for monitoring the power, flow and electrical and pneumatic consumption of a machine equipped with an IO-Link master and supervision and preventive maintenance software
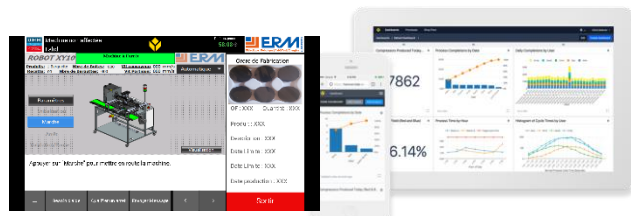

Visual instructions & Monitoring of production indicators on the Tulip open application environment and touchscreen tablet, for one machine (With a 3-year subscription to Tulip Pro, €1170 excl. tax per year beyond that) (Ref: UC51)

Electrical and pneumatic measurement sensors (IO-Link) for monitoring the power, flow and electrical and pneumatic consumption of a machine equipped with an IO-Link master (Ref: IO01)

Augmented Reality Scenario 'Taqtile Manifest'
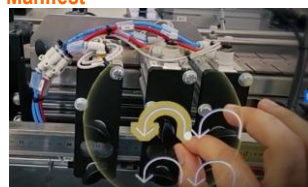
Augmented/mixed reality Manifest work instructions improve operational workflows so that tasks are performed more accurately and consistently.

Learn more about Taqtile Manifest: www.erm.li/tq

561, allée Bellecour-84200 Carpentras - France - Tel + 33 (0) 4 90 60 05 68
www.erm-automatismes.com - contact@erm-automatismes.com

5