SMART COFFEE FACTORY 4.0

This image is for illustrative purposes

DL RF-COFFEE

DESCRIPTION

The Smart Coffee Factory 4.0 recreates the environment of a connected company focused on producing a user-friendly product with a strong presence in educational institutions: coffee capsules. The concept of the factory of the future, combined with the use of advanced digital technologies, provides technicians with a comprehensive understanding of the industrial process, placing them at the very center of operations.

Through this educational approach, the production line operator and maintenance technician interact directly with all departments of the company, becoming part of a cohesive and multidisciplinary team. This system contributes to the enhancement of technological disciplines, and thanks to its progressive levels of complexity, it adapts to various training programs from CAP and professional Baccalaureate to BTS, BUT, engineering courses, and other vocational and professional certifications.

- Production flexibility, achieving a maximum output of 600 capsules per hour,
- Multi-product programming capability, allowing up to 50 different coffee recipes,
- Fully configurable parameters for complete operational control,
- Simple adjustment of both dosage and grind fineness,
- Compact design, occupying less than 1 m² of floor space.

INDUSTRY 4.0

Industrial Communication Networks
EtherNet/IP – Ethernet-based industrial communication for real-time control and advanced automation.
Modbus TCP/IP – Open protocol over Ethernet for efficient data exchange between industrial devices.
Modbus RTU (Serial) – Robust and reliable communication over serial links for traditional industrial environments.
IO-Link – Intelligent point-to-point interface for sensors and actuators, geared towards Industry 4.0.

Consist of:

- A compact and mobile system designed to fit seamlessly into any workshop, while remaining easy to move and transport, making it ideal for educational demonstrations and school events.
- It allows local or remote programming through a touchscreen HMI with a simple, intuitive interface, or via the ERP system.
- The platform offers extensive configuration options, including the adjustment of grind fineness, volume, temperature, and the type and number of capsules to be produced.
- Its multi-task production cycle integrates all essential operations: milling, tamping, weight control, capping, and capsule ejection.

WITH THE FOLLOWING STATIONS FOR PRODUCTION:

PRODUCTION STATION – (STATION: COFFEE CAPSULES PLANT PRODUCTION. IO-LINK VERSION)
Filling and sealing system for coffee capsules
This unit serves as the main production head of the line. It performs the key operations of distributing capsules, grinding coffee, dosing, packing the ground coffee, and thermo-sealing the lids.

CONTROL AND SORTING STATION – (STATION: IO-LINK CAPSULE WEIGHT AND COLOR CONTROL STATION)
Inspection, weighing, and sorting system for coffee capsules
This station performs weight verification of each capsule and visual identification through an automated process, consists of a brushless linear manipulator Weighing capsules with threshold sorting: good / bad Verification of capsule color a digital linear axis with brushless motorization, equipped with a carriage featuring a dual Venturi-based gripping tool. Each capsule is transferred to a precision weighing module and a color recognition sensor.

Main operations:

- Picking up the capsule.
- Placing it on the checkweigher and color sensor (both can be enabled/disabled via HMI).
- Transferring capsules to the packaging area by robot or cobot, or directing non-conforming capsules to a dedicated recovery bin, includes:
- 20 kg of Moka coffee (1 kg bags).
- Box containing 4,000 brown capsules + 1 sealing film roll.
- Electronic scale.
- Pod coffee machine.
- Cordless vacuum cleaner.

WORK MATERIAL PREPARATION STATION – (STATION: ROBOTIC COFFEE CAPSULE PACKAGING STATION)
Packaging system and coffee capsule box assembly

This station manages the organization and preparation of materials required for assembling coffee capsule boxes, ensuring compatibility with a collaborative robot that handles final packaging operations. The cobot assembles finished boxes containing the capsules, with various customization options available, the preparation module includes multiple distribution systems to ensure the versatility of the line, integrated with the ERP platform:

- Capsule storage and distribution unit.
- Can distribution unit.
- Device for inverted presentation of capsules for box base filling.
- Printer for inserting customized messages into the boxes.

These subsystems are primarily driven by pneumatic actuators.
Including:

- Robot cell with integrated support table.
- Gravity capsule turner for the main production line.
- Motorized conveyor belt for capsule feeding, equipped with presence detection sensors.
- UR3 collaborative robot featuring a pneumatic gripper with four suction cups.
- Complete setup for the Coffee Capsule scenario, including a Venturi tool, box magazine, and a set of boxes.
- Capsule dispenser for secondary production, supporting three different recipes.
- Capsule turner for orientation and positioning.
- RFID read/write head for manufacturing tracking and traceability.

- Thermal printer for customized messages, allowing personalization of each capsule box.

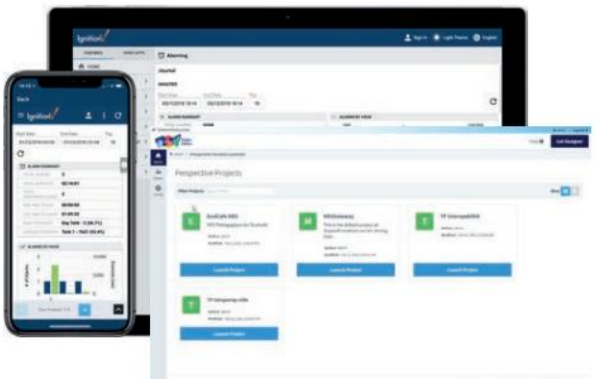
SOFTWARE PACKAGE AND INTERACTIVITY

Each production station in the line is equipped with an HMI of 5.7", providing complete parameter configuration capabilities, Mounted on the front panel of each unit, the color, graphic, and touch display centralizes operational data and presents an animated, instrumented synoptic view of the system. Through integrated communication features, the HMIs enable remote supervision of the entire line from a tablet, using a dedicated local Wi-Fi network.

INDUSTRY 4.0

SCADA

The SCADA platform supervises the production of coffee capsules and is provided as a base project containing a series of customized windows for the production line and its associated virtual roaster, data management is handled via PostgreSQL databases, pre-installed and configured on the server.



MES (Manufacturing Execution System)

Acting as an integrative platform, it connects various production-related functions, including quality control and maintenance management, Its purpose is to monitor both machines and operators, ensuring full traceability of manufacturing data under the “Know, Analyze, and Improve” principle—core to any continuous improvement methodology, The MES draws data directly from the SCADA, consolidates and structures it, and then feeds the ERP system, serving as a vital bridge for optimized production management.

Including:

- Software: Open-Source ERP and CRM integrated software platform for SCADA systems and MES.
- One PC, Two WiFi routers and One Android tablet.

ERP (Enterprise Resource Planning)

The ERP system manages customer relations, process planning, and company logistics, serving as the backbone for production coordination and resource management.

It provides the essential data for production scheduling, maintenance operations (CMMS and intervention planning), and the management of inventories, including both work materials and spare parts.

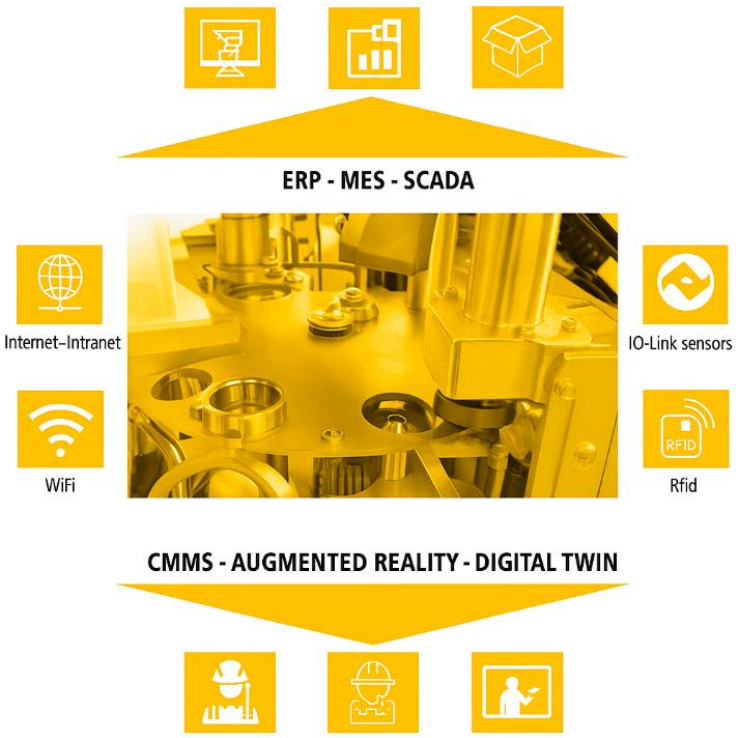
Powered by the data transmitted from the SCADA and MES systems, the ERP integrates and executes the following key functions:

- Detailed planning and resource status monitoring.
- Distribution and sequencing of production tasks.
- Product identification and traceability.
- Inventory tracking and work-in-progress management.
- Access to work instructions and control documentation.
- Performance analysis and reporting.
- Recipe management and production parameter control.
- Quality monitoring and continuous improvement tracking.

INDUSTRY 4.0

SOFTWARE PACKAGE

With its integrated software suite, the system establishes seamless connections between enterprise management applications, production operations, and virtual tools dedicated to analysis and maintenance support. Operators and maintenance technicians equipped with digital interfaces can access and visualize live data from the hardware layers of their systems. These visual elements overlay real-world components, providing intuitive and efficient guidance to support operation and maintenance activities.



AUGMENTED REALITY (AR)

Software Package Includes:

- A maintenance application dedicated to the Grinding–Capsule Filling subsystem.
- A preconfigured tablet for immediate deployment.

VIRTUAL REALITY (VR)

Software Package Includes:

- A VR application for startup and handling operations of the coffee capsule production machine.
- A configured gaming PC optimized for immersive simulation.
- A VR headset.