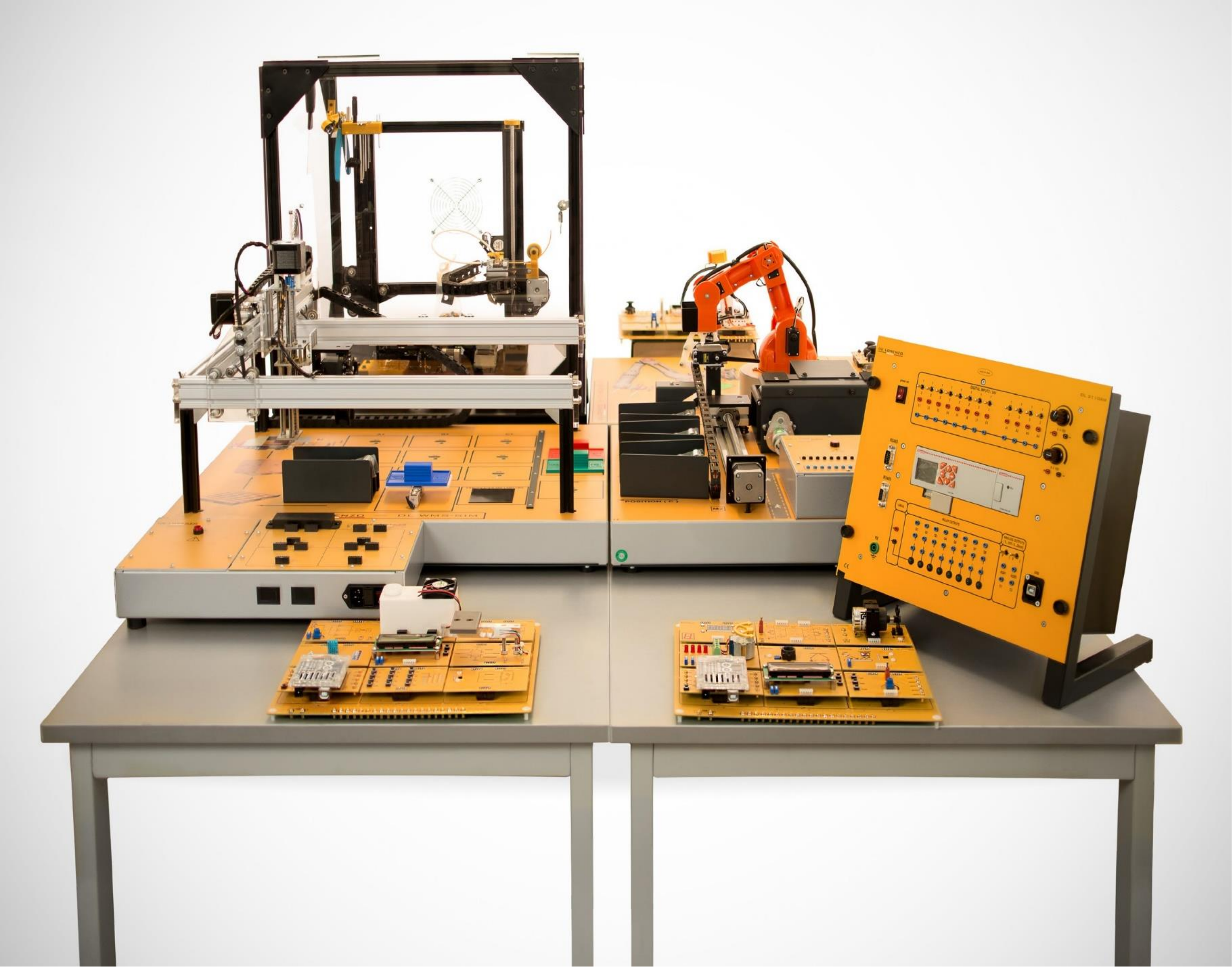
DL NGL

NEXT GENERATION LABS



DL NGL-I4.0 FACTORY

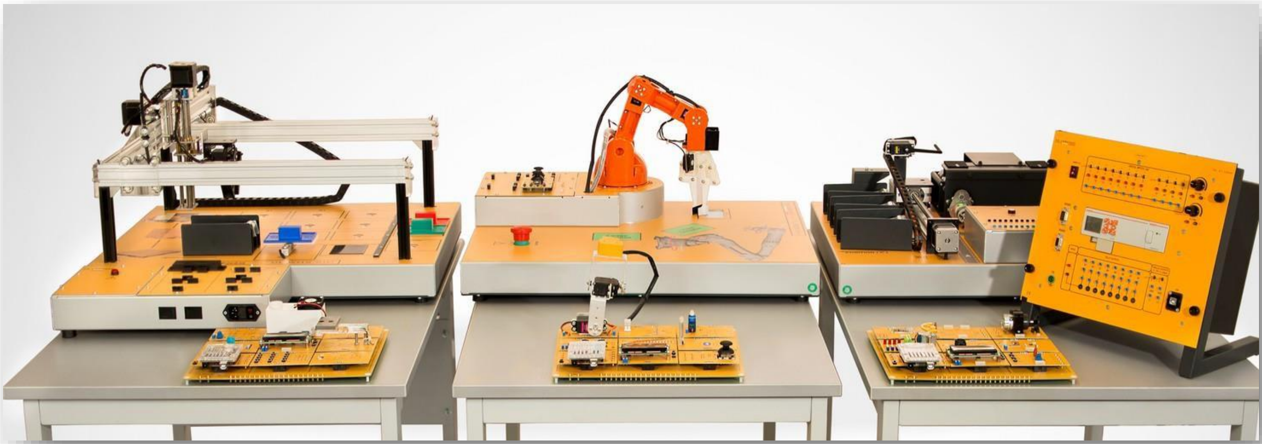
Module for the study of a Smart Factory

The digitization of information, combined with high-performance hardware, allows the implementation of more flexible and optimized production architectures. The level of innovation is such that, today, **Industry 4.0** is synonymous with smart manufacturing.

The digitization of the processes promotes the integration and cooperation within the company (smart manufacturing) and outside the company (smart supply chain), improving the quality of the information flow and optimizing the time to market of a product.

The **De Lorenzo** solution creates a collaborative environment to study the concepts related to **Industry 4.0**, integrating the subsystems present in a production plant.

The DL NGL-I4.0 FACTORY is composed of a set of electronic boards and simulators to create a small smart factory.



Using an **Arduino** open-source **microcontroller** connected to a **SCADA** supervisory software for data acquisition and system control, students will be able to perform practices covering topics from introductory automation and robotics to protocols of communication, to sensors and actuators up to a complete study of a production process.

The trainer consists of four subsystems. Each can be studied independently to perform practices covering topics ranging from the operation of sensors and actuators to the introduction of automation and robotics or connected together for the simulation of a more complex Industry 4.0 production line.

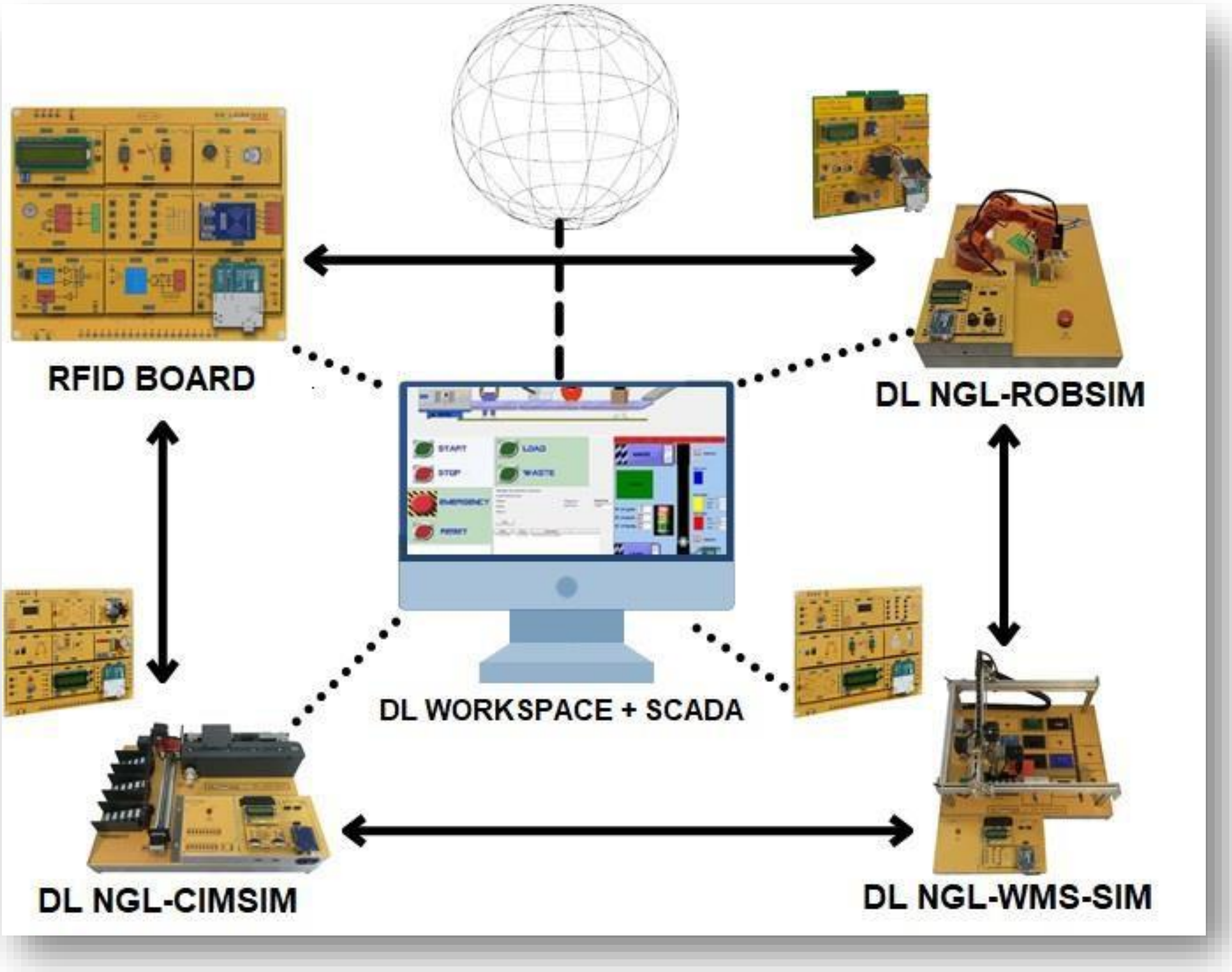
With the simulators and boards, the **DL NGL** interacts through a **gateway** software allowing the passage of information between devices that use different communication protocols, ensuring compatibility between them with their interoperability and providing a common interface for their communication.

The student can monitor, interact, acquire and analyze the data generated by the interactions between the stations to manage and optimize the entire industrial process.

Through an industrial **SCADA** software, all substations are able to exchange and display relevant information. The software is structured to follow a simulated manufacturing process that receives information from the user and generates report files that can be accessed remotely.

The **SCADA** software exchanges information with all the subsystems of the trainer, displaying sensor data and their status by monitoring the whole system in real time, and with the help of the **DL Workspace** it also exchanges information with all the stations of the teaching module.

The learning platform of the **DL Workspace** software is structured using a didactic approach, including the theoretical and practical information that are necessary to address the proposed topics.



With this module, the student will know the different parts that make up a real industrial process and will gradually learn the corresponding concepts.

He will start with the study of the basic hardware up to the practical development of a scale model of the production line.

The educational systems available for this application are the following:

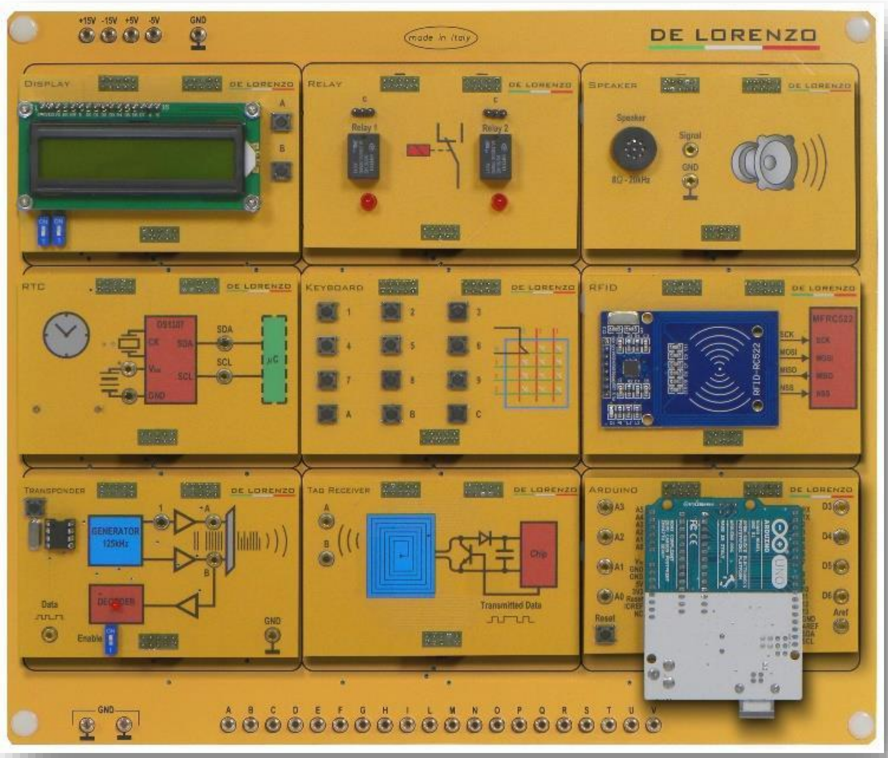
- **DL NGL-ROBSIM** (for the study of a robotic arm)**,**
- **DL NGL-CIMSIM** (for the study of a conveyor belt),
- **DL NGL-WMS-SIM** (for the study of a smart warehouse),

They are demonstrators complete with sensors and actuators representative of the characteristic mobility and handling properties of industrial robots, of conveyor belts, and of palletizers; they allow the development of complete courses on robotic control systems and are equipped with software for the study of automation and **Industry 4.0** concepts.

The **interface electronic boards** (the kits) include:

- the use of RFID in industrial environments for product traceability,
- the hardware characteristics and the control techniques used in a robotic system by means of an open-source microcontroller,
- the hardware characteristics and the control techniques used in a conveyor belt,
- the hardware characteristics and the control techniques used in a semi-automatic warehouse.

With the **RFID** application study kit alone, students can study the properties of this particular system and all of its components needed to develop an access control and door opening system.



Lessons and tools of the **DL Workspace** allow covering all the subjects of interest of the RFID technology, and the educational experiences cover the following topics:

- Reader behaviour when a tag is identified,
- How to read data from the proximity IC card using an RFID reader,
- How to read and write blocks of data on a MIFARE proximity IC card,
- How to write personal data to a MIFARE proximity IC card using an RFID reader,
- How to activate a relay using the microcontroller outputs,
- How to control a display using the microcontroller,
- How to control a real time clock device using the microcontroller,
- How to connect a keyboard to a microcontroller,
- Simulation of a door access control system.

For what concerns the **DL NGL-ROBSIM** system, it includes both the component kit and the hardware simulator.

- The kit helps to study and understand the hardware characteristics and control techniques used in a robotic system by means of an open-source microcontroller. The kit of boards includes all the components, sensors, and actuators needed to develop an educational robotic arm.
- The simulator implements a real hardware of a 5-axis robotic arm normally used in an industrial environment. Through this simulator, the student will be able to learn how to operate a robotic arm through a programmed microcontroller. Its structure allows connecting the components included in the kit of boards, making them compatible with each other.

Lessons and tools of the **DL Workspace** allow covering all the subjects of interest relevant to this **DL NGL-ROBSIM** system, and the educational experiences cover the following topics:

<u>For the kit of boards:</u>

- Characteristics of a joystick controller and interfacing with the microcontroller,
- Study of the servomotor and its controller,
- Introduction to the Bluetooth standard and implementation of its interface with the microcontroller,
- Analysis of the flexural sensor and its interface with the microcontroller,
- Study of an ultrasonic proximity sensor,
- How to control an LCD display through an I^2C communication interface,
- How to measure orientation and angular velocity using a gyroscope,
- Basic control technique: control a servo using a joystick,
- Basic control technique: Displaying the servo position on the LCD display.

<u>For the simulator:</u>

- Study of the robot components,
- Arm control in real time through Joystick,
- Programming of step-by-step movements,
- Registration of movements,
- Programming of positioning in the Cartesian plane,
- Communication via Bluetooth.

For what concerns the **DL NGL-CIMSIM** system, it includes both the component kit and the hardware simulator.

- The kit helps to study and understand the hardware characteristics and control techniques used in a conveyor belt. The kit of boards includes all the components, sensors and actuators to understand and manage the operation of an educational conveyor belt.
- The simulator implements a real hardware of a conveyor belt used in an industrial environment. Through this simulator, the student will be able to learn how to use and control a production line through the use of a PLC (supplied with the system) and an open-source microcontroller. Its structure allows the connection of the components included in the kit of boards, making them compatible with each other.

Lessons and tools of the **DL Workspace** allow covering all the subjects of interest relevant to this **DL NGL-CIMSIM** system, and the educational experiences cover the following topics:

<u>For the kit:</u>

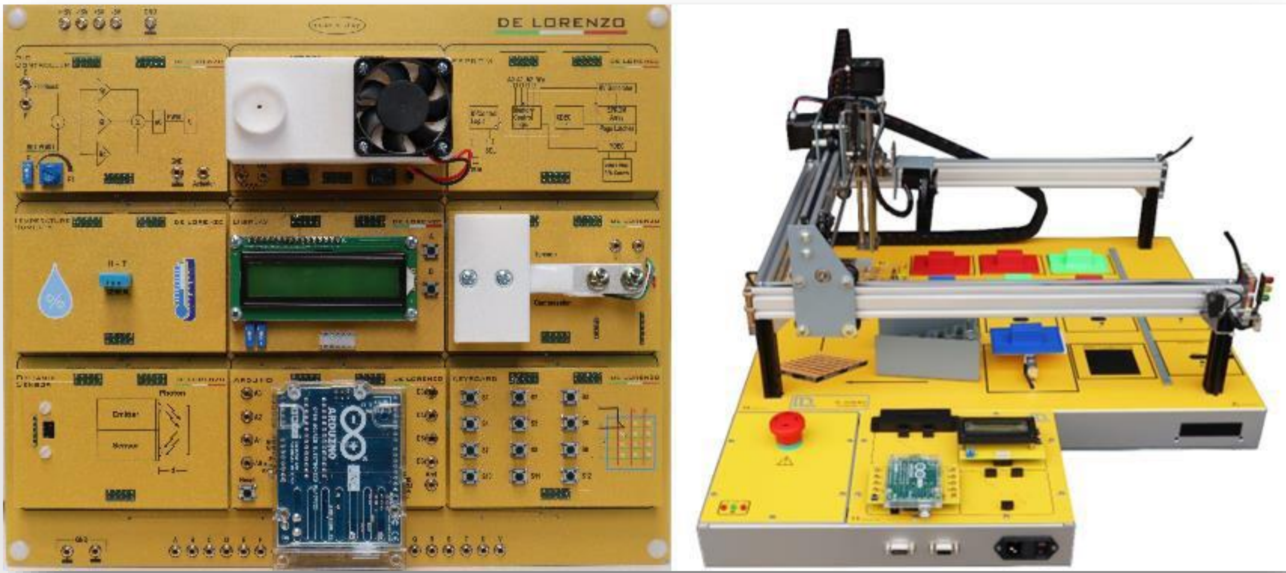
- Control of an LCD display via a microcontroller,
- Detection of an object using an infrared sensor,
- Monitoring of an RGB sensor,
- Control of a DC motor through a power driver,
- Control of a stepper motor,
- Action control and interlock function via a push button pad,
- Writing on a seven-segment display.

<u>For the simulator:</u>

- Control of a conveyor belt through a push button pad,
- Use of a PLC to control the movement of the conveyor belt,
- Monitoring and identification of a processed part on the conveyor belt,
- Tracking of the position of a part placed on the conveyor belt,
- Identification and check of the colour of a part,
- Identification of a defective part and placing it in the correct position at the end of the line.

For what concerns the **DL NGL-WMS-SIM** system, it includes both the component kit and the hardware simulator:

- The kit helps to study and understand the hardware characteristics and the control techniques used in a semi-automatic warehouse. The kit of boards includes all the components, sensors and actuators to understand and manage the operation of a semi-automatic educational warehouse.
- The simulator implements a real hardware of a semi-automatic warehouse used in an industrial environment. Through this simulator, the student will be able to learn how to use and manage a storage station. Its structure allows the connection of the components included in the kit of boards, making them compatible with each other.



Lessons and tools of the **DL Workspace** allow covering all the subjects of interest relevant to this **DL NGL-WMS-SIM** system, and the educational experiences cover the following topics:

For the kit:

- Weight measurement with a strain gauge,
- Outdoor temperature monitoring,
- Outdoor humidity monitoring,
- Implementation of a closed loop ON-OFF controller for a temperature-humidity cycle,
- Implementation of a closed-loop PID controller for a temperature-humidity cycle,
- Taking measurements with a distance sensor,
- Interfacing a keyboard with a microcontroller,
- Data storage on an external memory device.

For the simulator:

- Identification and weight of an article,
- Manual assignment of a position to an item,
- Automatic assignment of a position to an item,
- Automatic inventory update,
- Manual collection of an item from the warehouse,
- Automatic collection of an item from the warehouse.

The didactic approach of this smart factory can be summarized in three levels ranging from the most basic concepts of electronics and automation to the simulation of an industrial process, with the help of practical training platforms based on experiments:

1. **Level 1**: the boards included in the kits (electrical interface boards) make it possible to study the individual components that are part of the different stations such as the relative sensors and actuators;
2. **Level 2**: the integration of the stations of real components in subsystems through the Arduino microcontroller;
3. **Level 3**: the integration of the entire factory with its stations through a **SCADA** system for monitoring, handling, and control of the entire production process with the aid of the CAI **DL Workspace** software.

The SCADA software is structured to follow a simulated manufacturing process that receives information from the user and generates report files that can be accessed remotely.
Implemented processes include:

- Processing of a sales order,
- Generation of a production order,
- Generation of a purchase order,
- Management and maintenance of various bills of materials,
- Production process monitoring,
- Management of the inventories,
- Creation of packing lists.

All relevant historical data is recorded on the **RFID** tag.
The software includes all the necessary theoretical and practical information and is Open with a license that allows students to create their own projects and customize them with an intelligent management by generating automatic reports and controlling the actuators of a production process, and with the possibility also of monitoring and acting remotely in an Internet network in real time.

With the **Smart Factory** module, students will be able to:

- develop applications using programming and control techniques,
- simulate real scenes,
- develop analytical and problem-solving skills.