IIOT BASED SMART FACTORY WITH 7 AXES ROBOTICS

Smart Factory from Hytech Didactic is an IIOT based flexible manufacturing system. Entire system consists of 4 modular stations along with a fifth station which is a robotic gantry. Each station can be operated in individual mode as well as in integration mode. Bearing assembly is carried out with the help of pneumatic gauging, vision inspection as well as barcode reading. Robot (7 Axes Robot with Linear gantry axis) is fully integrated with the smart factory through SCADA and MES. Production optimisation system along with Automatic Storage and Retrieval System is also provided in the system with photo sensors. The entire system operates on a SCADA which can be programmed by the users along with MES (Manufacturing Execution System).

Hytech Didactic Smart factory is also equipped with remote commissioning software (Siemens Mechatronics Concept Designer) and Siemens Technomatix which acts as a digital dynamic Twin with factory simulation. Users can design entire PLC ladder in 3 dimensional workspace in Siemens MCD.

Cloud Platform from Siemens Mindsphere is an Industrial IIOT platform providing capability to students to ganther data points and remote operations with customisable dashboards.

- Operate each station doing PLC Ladder Programming **(Siemens TIA**)

- Integrate all stations with SCADA **(Siemens WinCC)**

- Design Runtime as per user requirement Virtual Commissioning and PLC Ladder Updation with **Siemens Mechatronics Concept Designer (MCD).**

- Complete Process Simulation and Robot Offline Programming using **Siemens Technomatix**

- Complete operation usin **Manufacturing Execution System (MES) from Siemens OPCENTER**

- IIOT Integration and Data collection with **SIemens Mindsphere**

Major Components in IIOT / Industry 4.0 based smart factory solution:

- Vision Sensor with Ethernet communication
- Industrial 6 Axes Robot
- Robot Transfer Unit (7th Axis of Robot) with servo motor
- Barcode printing and scanning system
- Industrial SCADA
- Industrial IOT Platform
- PLC for each IIOT Station – Siemens S7 1200 – 1215C
- HMI (9 inch Industrial HMI)
- Linear slide with Servo Motor
- Pneumatic Gauging system
- Dynamic digital twin with IIOT Communication
- Perpetual software license for PLC operation (Siemens TIA)
- Perpetual operation and user license for Industrial SCADA (Siemens WinCC Professional)
- Separate PLC for Central Control Unit with Siemens S7 1500 – 1512C PLC
- Industrial workstation with dual monitors

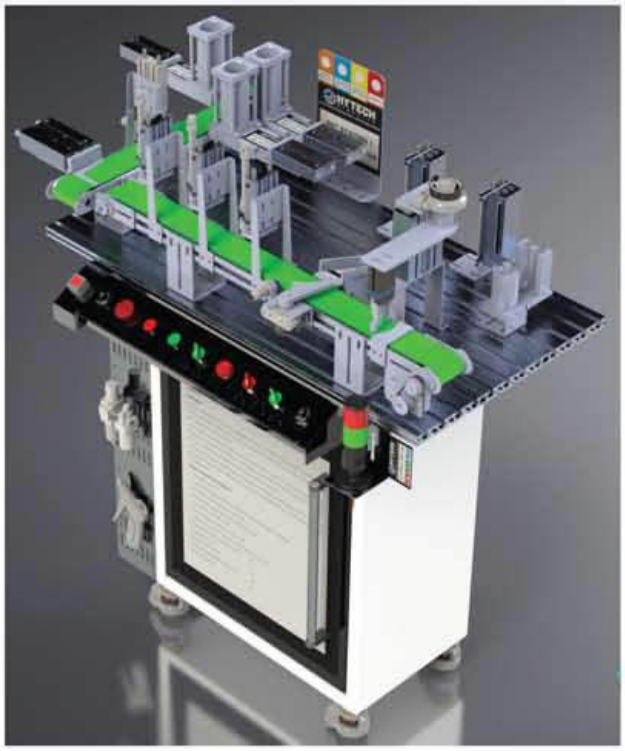
List of training exercises / experiments:

- PLC Training
- HMI Training
- SCADA Training
- Robot (6 Axes Industrial Articulated) Training
- Integration of PLC – HMI and SCADA
- Integration of Robot with PLC and SCADA
- IIOT Training
- Vision Sensor Teaching and Integration with PLC – HMI - SCADA
- Digital Twin Operation with OPC UA
- Servo Motor Training
- Factory Design and Simulation Training
- Complete System Integration and Automation
- MES Integration
- Factory Simulation and Offline Robot Programming

Training Module Mapping:

Station Details	Station 1	Station 2	Station 3	Station 4	Station 5
Training Modules	Pneumatic Gauging Station	Vision Inspection Station	Assembly Station	Automatic Storage and Retrival Station	Gantry Based Robot
Pneumatics					
Sensors					
PLC					
HMI					
SCADA					
Servo					
Vision					
Robotics					
Robot - PLC Integration					
MCD Based Remote Commissioning					
Digital Twin					
MES					

Station 1: Pneumatic Gauging Station



Major Components in Station 1:

1. Conveyors, Qty: 02
2. Pneumatic Gauging system for sorting of three different types of bearings
3. Rotary Pick and Place station (Pneumatic)
4. Auto feeder designed for 47mm bearing diameter
5. PLC, Siemens S7 1200 – 1215C
6. RJ 45 connector for direct access of HMI
7. Direct access of IIOT / Industry 4.0 with Wifi communication

Communication	
Integration with 6 Axes Industrial Robot	: Yes
Integration with IIOT	: Yes
Integration with SCADA	: Yes
Integration with Dynamic Digital Twin	: Yes
Individual Operation	: Yes

Operation:

Station 1 is equipped for pneumatic gauging system which will sort out three different types of bearings having same outer diameter but varying inner diameter. Any bearing other than three predefined bearings will be rejected in station 1.

Auto feeder is provided along with a conveyor system which a user can utilize for storage of jobs to optimize the cycle time.

First station is synchronized with Robot and RTU for pick up of jobs and loading them into the next station. IIOT Station 1 can be used in individual mode as well. It is equipped with PLC which can be accessed by CCU Workstation.

Station 2: Vision Inspection Station

Major Components in Station 2:

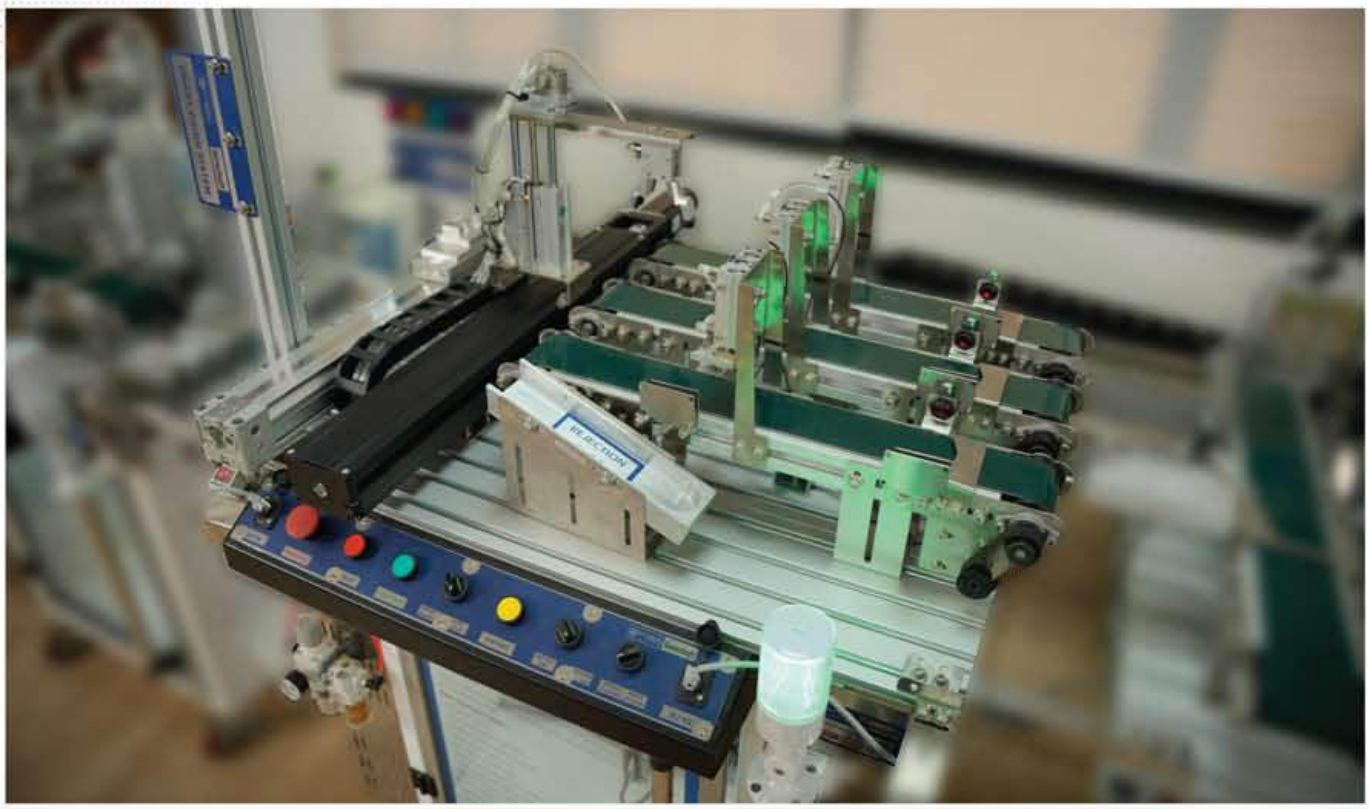
1. Conveyors, Qty: 03
2. Vision inspection system (iR Vision)
3. Rotary Pick and Place station (Pneumatic)
4. Linear slide with servo motor
5. PLC, Siemens S7 1200 – 1215C
6. RJ 45 connector for direct access of HMI
7. Direct access of IIOT / Industry 4.0 with Wifi communication

Communication	
Integration with 7 Axes Industrial Robot	: Yes
Integration with IIOT	: Yes
Integration with SCADA	: Yes
Integration with Dynamic Digital Twin	: Yes
Individual Operation	: Yes

Operation:

Station 2 is equipped with vision inspection system. Any component with a dimension beyond the tolerance limit will be rejected by the vision inspection system. Depending on the vision inspection system, three types of bearings will be sorted on three different conveyors whereas the rejected items will be placed in a bin.

Sorting on three conveyors is done with pneumatic rotary pick and place unit and linear slide equipped with high speed servo motor.



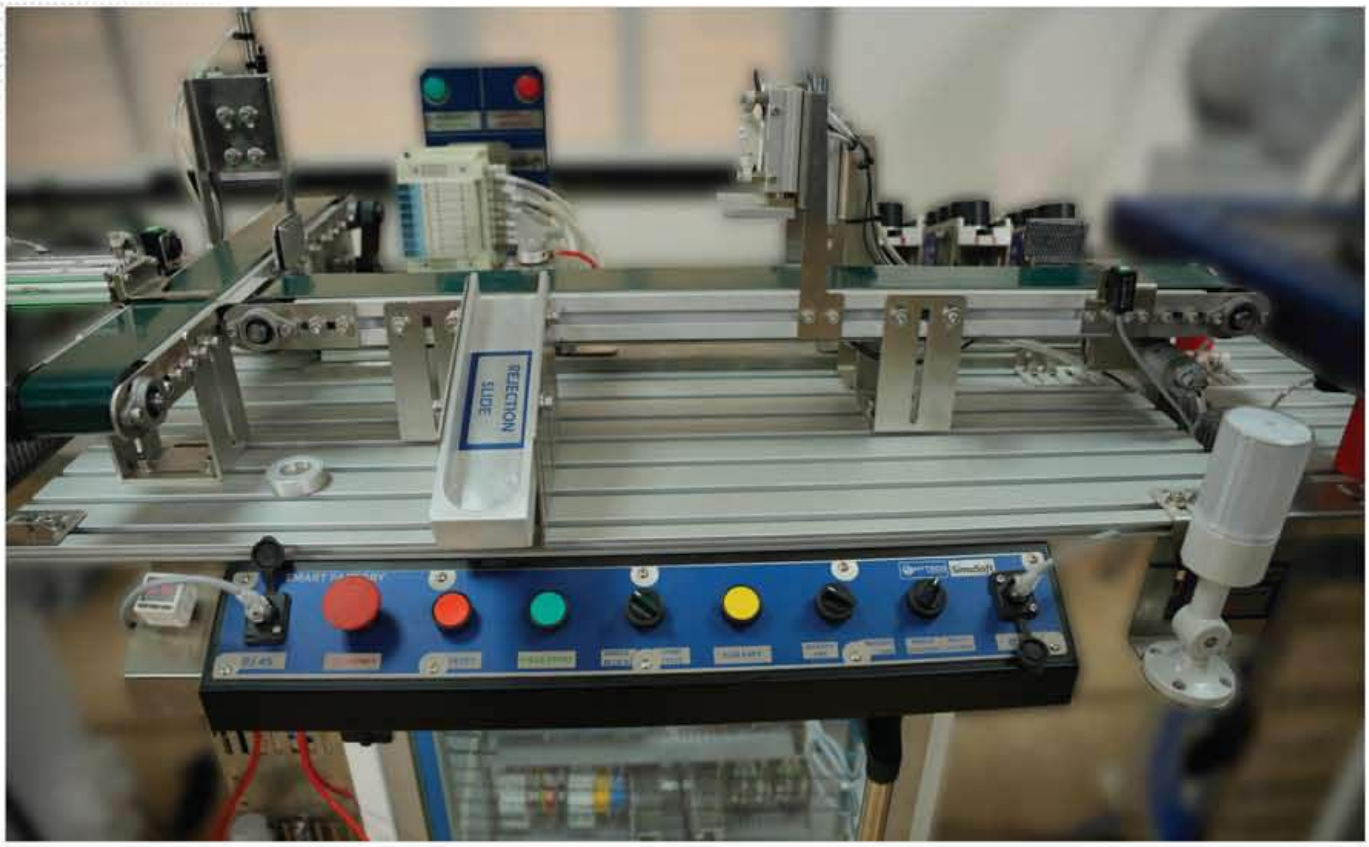
Station 3: Assembly Station

Major Components in Station 3:

1. Conveyors, Qty: 02	
2. Pneumatic Press System	
3. Shafts storage units with sensor feedback	
4. PLC, Siemens S7 1200 – 1215C	
5. RJ 45 connector for direct access of HMI	
6. Direct access of IIOT / Industry 4.0 with Wifi communication	
Communication	
Integration with 7 Axes Industrial Robot	: Yes
Integration with IIOT	: Yes
Integration with SCADA	: Yes
Integration with Dynamic Digital Twin	: Yes
Individual Operation	: Yes

Operation:

Station 3 is an assembly station where assembly of sorted bearings and corresponding shafts takes place. The assembled bearings and shafts are tested in a pneumatic gauge. Shafts are marked with barcode which is scanned to assign Unique Identification Number to the assembly.
Assembled shafts which are approved in pneumatic gauging are transferred to next station whereas the rejected assemblies are sorted in a bin.



Station 4: Automatic Storage and Retrieval Station

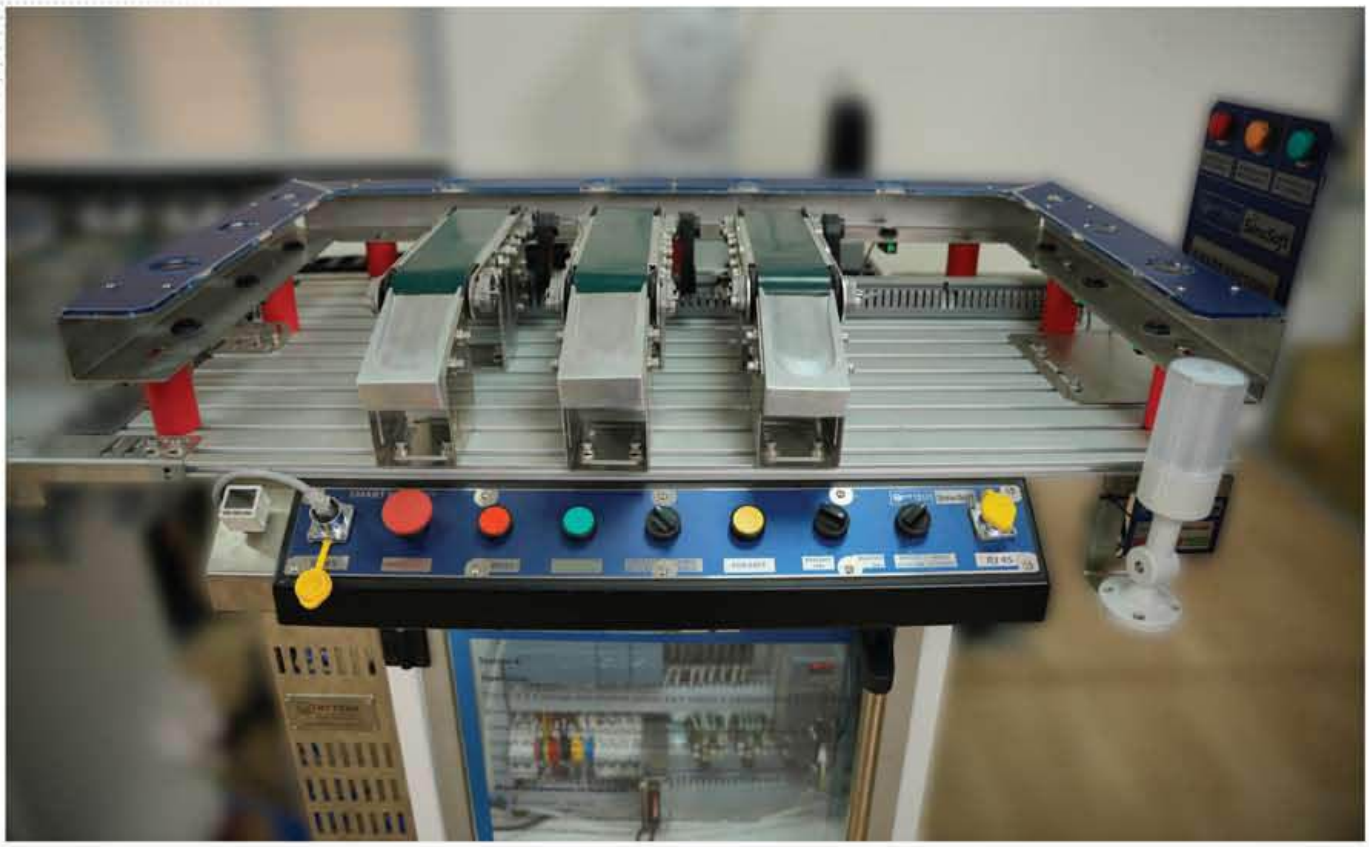
Major Components in Station 4:

1. Conveyors, Qty: 03	
2. Automatic Storage and Retrieval System with status feedback	
3. Photosensor for each storage position	
4. PLC, Siemens S7 1200 – 1215C	
5. RJ 45 connector for direct access of HMI	
6. Direct access of IIOT / Industry 4.0 with Wifi communication	
Communication	
Integration with 7 Axes Industrial Robot	: Yes
Integration with IIOT	: Yes
Integration with SCADA	: Yes
Integration with Dynamic Digital Twin	: Yes
Individual Operation	: Yes

Operation:

Station 4 is a storage and retrieval station. Each station is equipped with a sensor which gives dynamic output directly to IOT Platform.

Depending on the production schedule, assemblies from automatic storage and retrieval system are transferred to output conveyors. Subsequently, next batch of production should initiate to replenish the stock. The conveyors act as delivery means to deliver the ordered products.



Central Control Unit:

Central Control unit is equipped with workstation as well as central PLC (Siemens S7 1512C) which controls the complete smart factory.

7th axis of robot also known as RTU is also controlled from Central Control Unit (CCU). CCU is provided with operational interface for complete smart factory operation. Digital twin software is interfaced with CCU workstation with the help of OPC UA. SCADA screen as per user requirement can be designed on CCU.

RTU Referencing can be carried out from CCU. All software which are required for Smart factory operation are installed in CCU Workstation.

List of FA Software Installed in CCU Workstation:

- Siemens Win CC for S7 1512 PLC and Siemens KTP 900 Operation
- Siemens WinCC Advance User and Developer License (SCADA)
- Digital Twin – Siemens Technomatix
- Virtual Commissioning – Siemens MCD
- MES – Siemens OPCenter
- Cognex / Fanuc Vision Camera operation and teaching

List of Major Components in CCU:

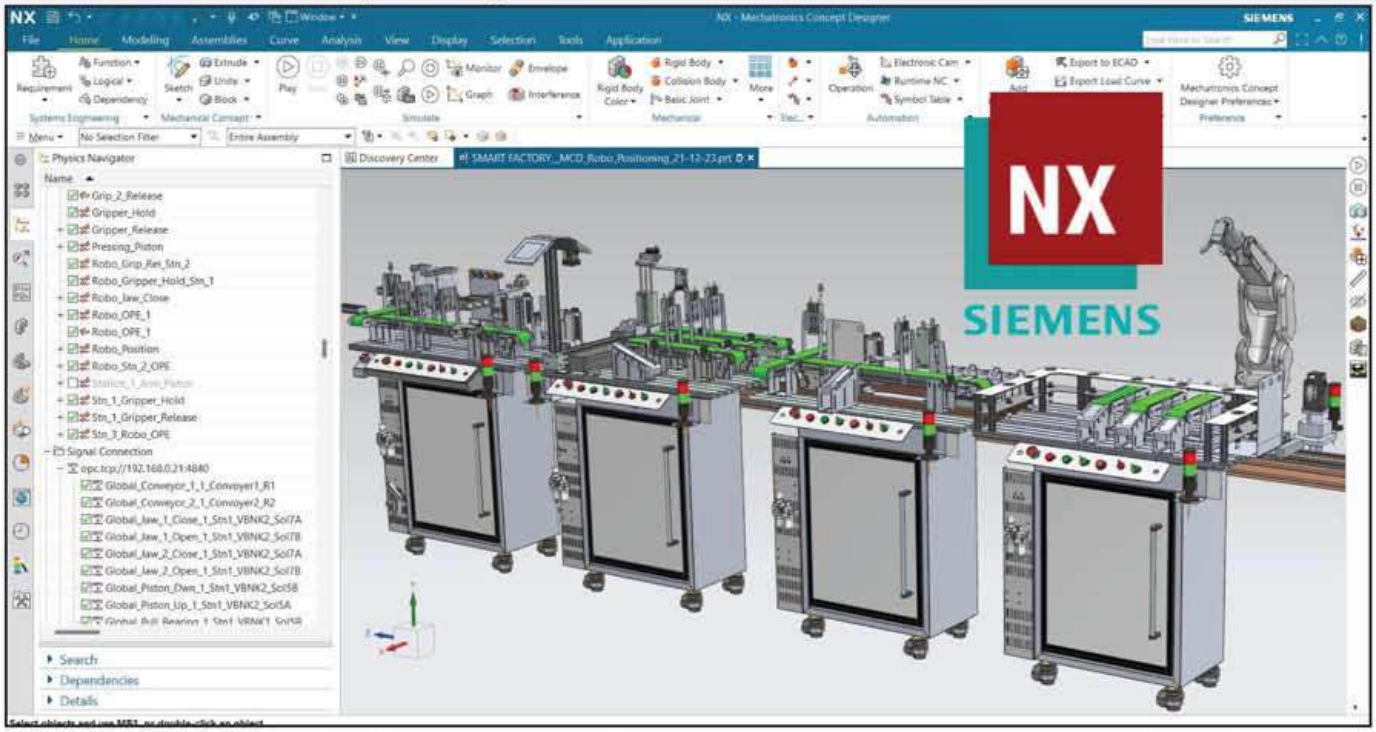
Workstation with Windows 10 Professional Licensed Software

Operation Panel (Hardware)

Dual monitors with mounting stands

Siemens S7 1500 – 1512C PLC

Mechatronics Concept Designer :



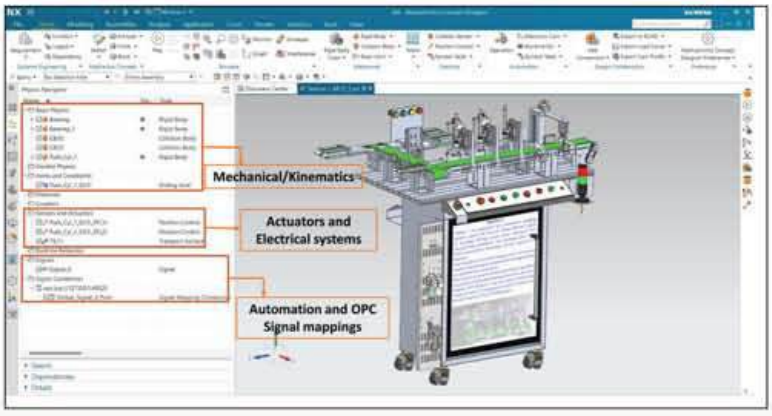
Mechatronics Concept Designer is a new solution for concept design of mechatronics products. The software enables 3D modeling and simulation of concepts with multi-body physics and automation-related behavior typically found in mechatronics products. Supporting a functional design approach, Mechatronics Concept Designer integrates upstream and downstream engineering domains, including requirements management, mechanical design, electrical design, and software/automation engineering.

Relevance

Mechatronics Concept Designer supports a new approach for functional machine design. A functional decomposition serves

as a common language between mechanical, electrical, and software/ automation disciplines, enabling them to work in parallel. This approach ensures that the behavior and logical characteristics of mechatronics requirements are captured and supported from the earliest stages of product development. With this functional machine design approach, Mechatronics Concept Designer facilitates interdisciplinary concept design up front. All engineering disciplines can jointly and concurrently work on a project:

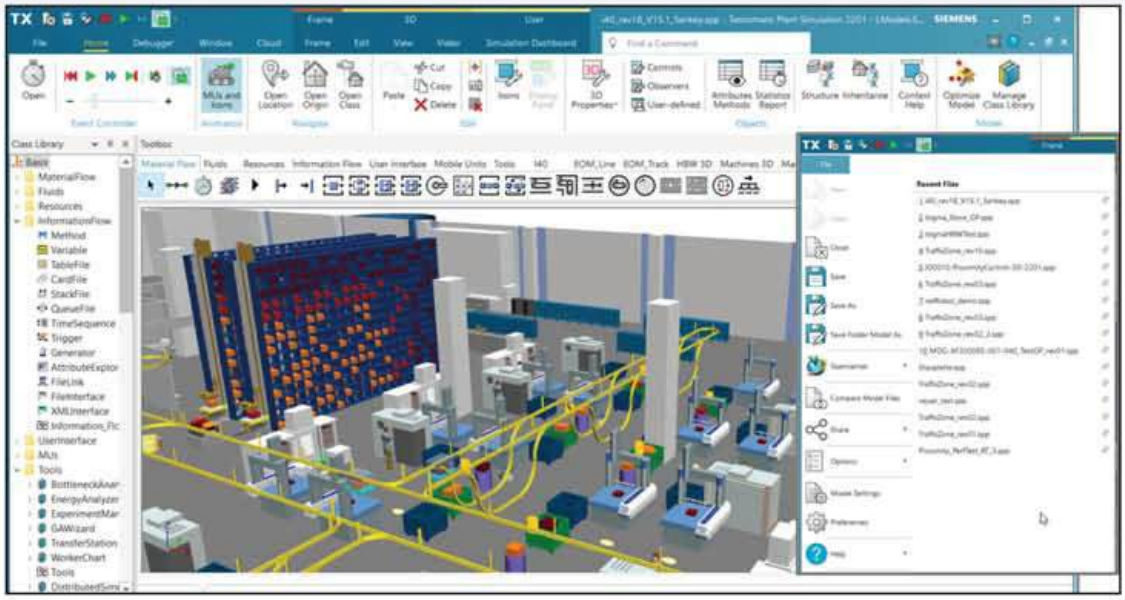
- Mechanical engineers can create the design based on 3D shapes and kinematics.
- Electrical engineers can select and position sensors and actuators.
- Automation programmers can design the basic logical behavior of the machine, starting with time -based behavior and then defining eventbased controls.



Courses

- Integrated Systems Engineering
- Concept modeling and physics-based simulation
- Open interfaces for Mechani cal Design, Electrical Design and Automation Design
- Virtual commissioning
- Integration with PLC and SCADA
- Dynamic Process Simulation

Tecnomatix



A digital manufacturing solution for manufacturing process verification in a virtual 3D environment, Process Simulate is a major enabler of speed-to-market. It accomplishes this by helping manufacturing organizations to validate their manufacturing concepts from the outset and throughout the lifecycles of new products they introduce. The takeaways here are faster launches and higher production quality as the 3D data produced for products and resources help groups to validate, optimize, and commission complex manufacturing processes.

Relevance

Plan and simulate robotic motion

Create, examine and verify complex robotic motion paths and processes with a complete set of manual and automated robotics simulation software tools. Facilitate the most realistic discrete and continuous simulation of various manufacturing processes and mechanical procedures for robots, tools and devices, as well as the control logic used to drive them in production. Facilitate the most realistic discrete and continuous simulation of various manufacturing processes and mechanical procedures for robots, tools and devices, as well as the control logic used to drive them in production.

Commission production systems virtually

Streamline the flow of data from conceptual design to the shop floor. Leverage a common integration platform for the mechanical and electrical disciplines participating in commissioning of automated production systems. Simulate real controller code and robot programs combined with actual hardware in a realistic virtual commissioning environment to verify complete system function before starting production.

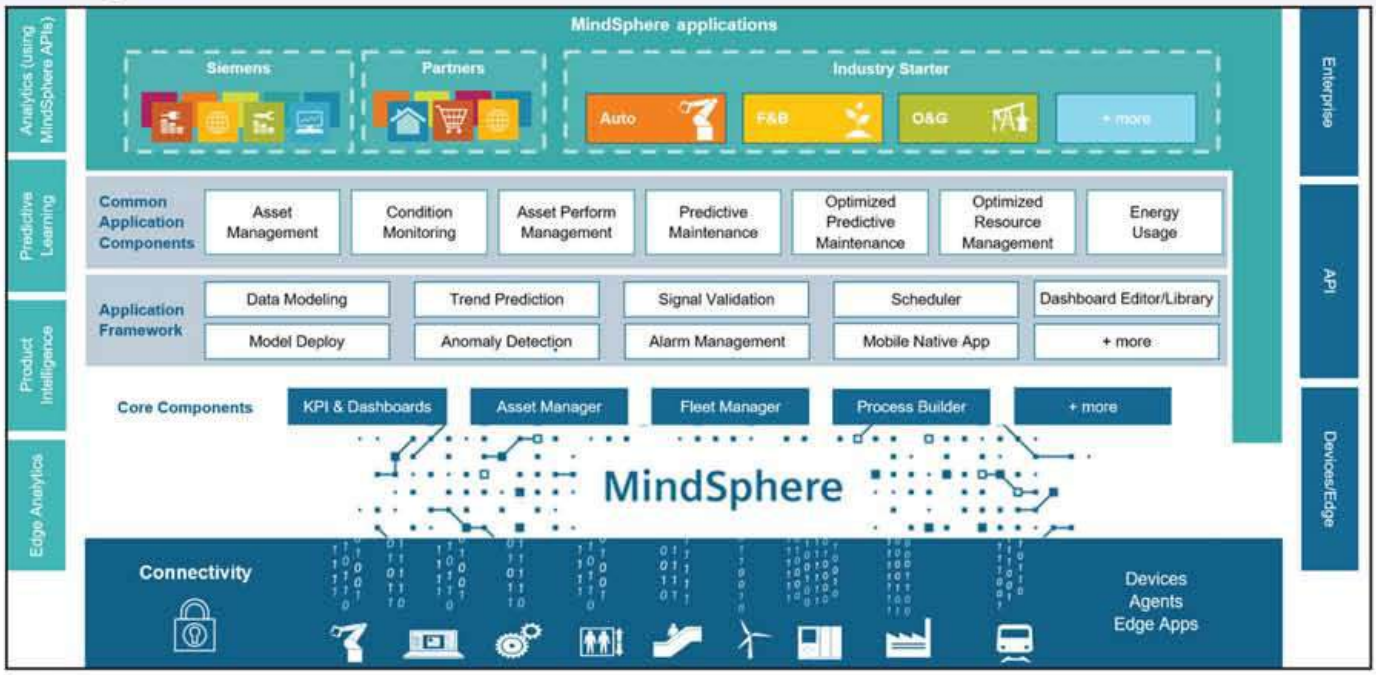
Case Studies

Use Tecnomatix to check various material handling processes as well as various other automation components from library to optimise the cycle time of Smart Factory Setup

Courses

- Design complete kinematic workcells
- Plan and simulate robotic motion
- Program robots completely offline
- Commission production sys tems virtually
- Factory Simulation
- Tecnomatix as a Digital Twin

Mindsphere



MindSphere, the industrial IoT as a service solution from Siemens, enables industries worldwide to link their machines and physical infrastructure to the digital world easily, quickly and economically. Harnessing data

from virtually any number of connected intelligent devices, enterprise systems and federated sources allows for analysis of real-time operational data. This analysis then leads to optimized processes, resource and productivity gains, the development of new business models and the reduction of operations and maintenance costs. Companies leveraging MindSphere boost performance, sharpen their competitive advantage and realize much more profitability.

With MindSphere, users are able to leverage Siemens' deep knowledge and domain expertise in automation and digital services. In fact, Siemens is a leading automation provider, delivering critical operation and automation technology through global deployments of:

30 million automation systems

75 million contracted smart meters

1 million-plus connected products in the field

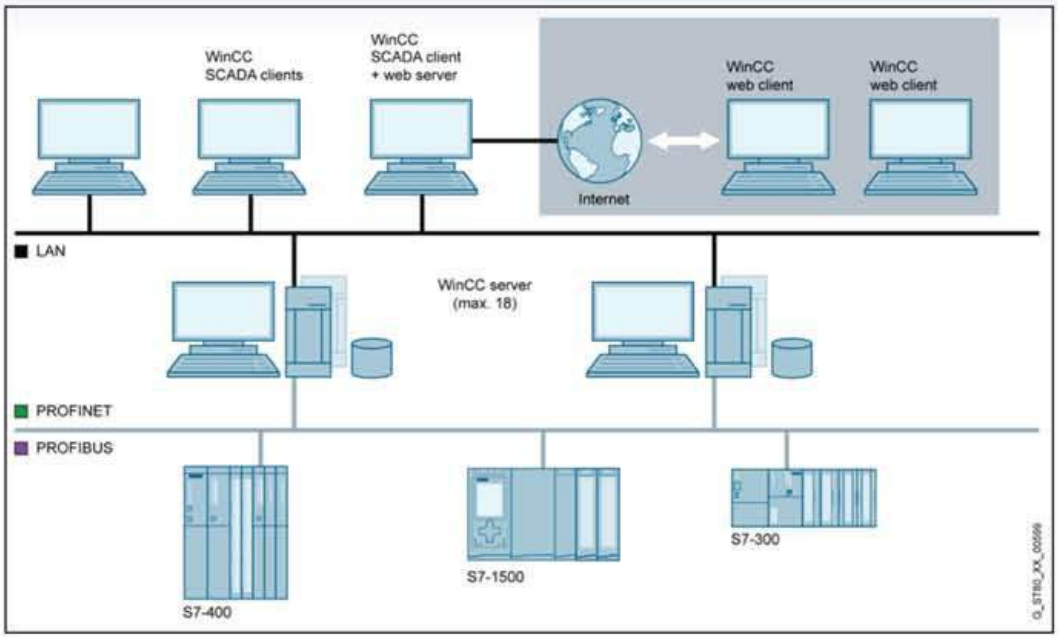
Siemens business units have developed IoT solutions for their industries and are building additional ones, contributing to the continuing growth of MindSphere applications and capabilities.

Users can make use of Siemens Mindsphere to devise various applications suitable for SMart Factory Applications. Various screens as well as dashboards can be prepared for different types of datapoints

Courses

- MindSphere architecture
- Mindsphere Applications
- Industrial IoT as a service
- Mindsphere Connectivity
- How MindConnect works - Protocols
- How MindConnect works - Data security
- MindConnect Integration with Cyber Physical Systems

SCADA (Developer and Runtime):



The SCADA acronym stands for Supervisory Control and Data Acquisition.

A SCADA system is a collection of both software and hardware components that allow supervision and control of plants, both locally and remotely. In Hytech Smart Factory, SCADA collects data from PLCs of each station and allows the user to supervise the data centrally from CCU. The SCADA also examines, collects, and processes data in real time. Human Machine Interface (HMI) software facilitates interaction with field devices such as conveyors, valves, motors, sensors, vision camera, etc. Also within the SCADA software is the ability to log data for historical purposes.

That communication data is routed from the processors to the SCADA computers, where the software interprets and displays the data allowing for operators to analyze and react to system events.

SCADA used in Hytech Smart factory is a real world SCADA system which is used for the integration of entire manufacturing process providing users with hands on experience on the one of the most commonly used technology in automation industry.

Relevance

Industry 4.0 represents a breakthrough in the integration of technological innovations in production and operations using smart technologies.

It is a field data collection system that has sensors connected to a master station in a factory, plant or other remote location, and then sends this data to a central computer and this process is carried out in real time. SCADA (Supervisory Control and Data Acquisition) is used to monitor and control industrial equipment in virtually any industry at various stages of the development, production or manufacturing process.

Courses

- SCADA and PLC HMI Integration
- Developing SCADA Runtime
- Smart Factory Operation using SCADA from Central Control Unit
- Industry 4.0 / IIOT Based remote SCADA operation and data acquisition
- SCADA and Digital Twin Integration

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