HYTECH DIDACTIC

ROBOTICS

Spot Welding

Spot Welding Robot Training Cell with PLC, HMI and IIOT

www.hytechdidactic.com

Hytech Robotic Spot Welding Training Setup

The **Hytech Robotic Spot Welding Training Setup** is a state-of-the-art training system designed to replicate real-world industrial environments and provide learners with hands-on exposure to robotic welding technologies. It is ideal for technical institutes, skill development centers, and industry training programs aiming to prepare students for modern manufacturing roles.

The **Hytech Robotic Spot Welding Training Setup** offers a comprehensive, flexible, and industry-grade platform to train the next generation of welding professionals. With features like modular tables, servo-driven automation, integrated tip cleaning, and a self-contained water system, it provides everything required to bridge the gap between classroom theory and industrial practice.

Whether used for basic skill development or advanced IIoT-enabled automation training, this setup ensures that learners are well-prepared for the demands of modern smart manufacturing.

- ## Modular Training Tables with Aluminum Extrusions

  The setup includes four independent training tables, designed using industrial-grade aluminum extrusions. These modular tables allow users to:

  - Easily reconfigure job positions to understand different welding scenarios
  - Simulate real-world part handling and assembly conditions
  - Encourage creativity and adaptability in programming and workstation layout

  This flexibility significantly enhances the learning experience by allowing exploration of various welding angles, positions, and job geometries.

Hytech Robotic Spot Welding Training Setup

- ## Servo Motor-Based Automated Welding Arm

  At the heart of the setup is a servo-driven robotic arm integrated with a PLC-controlled automation system. This combination provides:

  - Real-time motion control and precision
  - Realistic industrial programming and interlock logic training
  - Seamless integration with other automation components such as sensors and actuators

  This mirrors actual plant-floor operations, making the training truly industry-relevant.

- ## Built-in Tip Cleaning Station

  To emphasize welding quality and maintenance, the Hytech setup comes with an integrated tip cleaning station. This feature helps learners understand:

  - The importance of regular maintenance for consistent weld quality
  - How to automate tip cleaning processes in production environments

- ## Self-Contained Water Circulation System

  Unlike conventional systems that rely on a permanent water line, the Hytech system includes:

  - A dedicated water tank with pump for closed-loop water circulation
  - Efficient cooling for the welding tips and electrodes
  - Elimination of the need for external plumbing or continuous water supply

  This not only meets mandatory cooling requirements for spot welding but also makes the setup portable and easy to install in educational environments.

Importance of Training on Robotic Spot Welding Setup Integrated with PLC, HMI, & IIoT

In today's rapidly evolving manufacturing landscape, robotic spot welding has become a cornerstone of automotive and heavy industry production lines. With increasing emphasis on automation, quality, and efficiency, training students and professionals on modern, industry-ready robotic spot welding systems is no longer optional — it's essential.

1. Industry-Relevant Skill Development

A robotic spot welding cell integrated with PLC (Programmable Logic Controller) and HMI (Human-Machine Interface) replicates real-world industrial setups. Training on such systems equips learners with:

- Hands-on experience with robotic welding arms and spot welding guns
- PLC programming for cell control, interlocks, and safety
- HMI operation for monitoring, diagnostics, and user interface design

These skills are directly transferable to job roles in automotive, white goods manufacturing, and industrial automation sectors.

2. Safety Protocols and Interlocking Logic

Real-world robotic welding cells operate under stringent safety and interlocking mechanisms controlled through PLC logic. Training allows users to:

- Understand and implement safety zoning, emergency stop circuits, and access control
- Simulate fault scenarios and develop fail-safe logic
- Learn how to design robust interlocking sequences to protect equipment and operators

3. Smart Manufacturing and IIoT Integration

With Industry 4.0 becoming the new standard, integrating IIoT (Industrial Internet of Things) into training setups bridges the gap between traditional automation and digital transformation. Learners can:

- Capture welding data (cycle times, weld quality, current, voltage, etc.) in real time
- Use edge devices or cloud platforms for remote monitoring and predictive maintenance
- Understand the role of data analytics, connectivity, and cloud integration in smart factories

4. Troubleshooting and Maintenance

Training on a PLC-HMI integrated robotic spot welding setup fosters a deep understanding of system diagnostics and maintenance:

- Use HMI dashboards for real-time alerts and system feedback
- Perform root cause analysis of welding failures or system breakdowns
- Develop preventive maintenance strategies based on IIoT-enabled data logging

5. Bridging the Education-Industry Gap

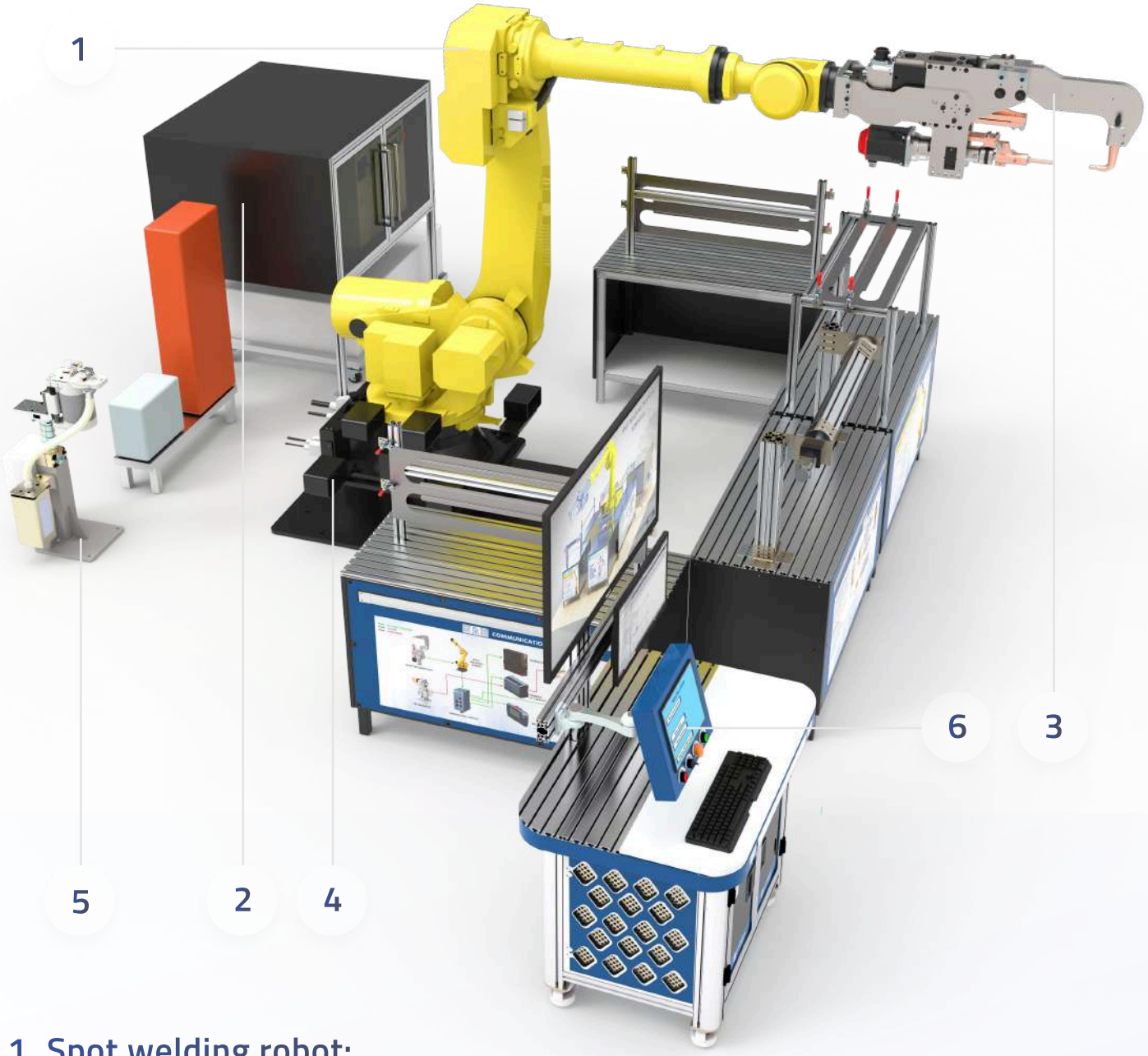
Educational institutions offering this kind of integrated training can ensure their students are industry-ready from day one. Employers benefit from reduced onboarding time and higher productivity, while students gain a competitive edge in job placements.

Integration with Smart Manufacturing

Robotic spot welding is no longer a luxury — it's a necessity in competitive manufacturing. Its applications span **automotive, heavy machinery, appliances, and beyond**, making it an essential skill and investment for industries focused on quality, speed, and scalability. As automation continues to advance, robotic spot welding will remain a critical process in shaping the factories of the future.

- **PLC-based control systems** for safety and interlocks
- **HMI interfaces** for monitoring and diagnostics
- **IIoT platforms** for remote tracking, data logging, and predictive maintenance. This integration makes them central to **Industry 4.0** initiatives, enabling real-time visibility and optimization across manufacturing operations.

Core Components That Drive Performance



1. Spot welding robot:

The FANUC Spot Welding Robot is a 6-axis industrial robot designed for precise and consistent spot welding operations. It handles heavy welding guns and delivers accurate welds in high-volume applications like automotive manufacturing. With strong rigidity and seamless integration with spot welding timers, it ensures high-speed, high-quality welds with minimal operator intervention.

2. Cabinet for Robot Controller:

This cabinet securely houses the FANUC robot controller, ensuring safe operation and organized wiring. It includes proper ventilation and protection features to maintain optimal performance and longevity of the controller. The cabinet supports easy access for maintenance while keeping the work area tidy and secure.

Core Components That Drive Performance

3. Obara MFDC Gun

The Obara MFDC (Medium Frequency Direct Current) Spot Welding Gun is a high-performance welding gun used with industrial robots for fast, consistent, and high-quality spot welds. It delivers stable current with reduced heat loss, ensuring minimal spatter and excellent weld strength. Its compact, lightweight design makes it ideal for robotic applications in automotive and sheet metal industries.

4. Pedestal for Robot Mounting

The pedestal is a critical support structure designed to handle the weight and inertia of the spot welding robot. Made from heavy-duty mild steel with a minimum weight of 165 kg, it ensures rigidity and vibration resistance. The pedestal is chemically grouted to the floor, providing strong anchoring and stability during high-speed welding operations.

5. Tip dresser for spot welding

The tip dresser is an automatic maintenance tool used to clean and reshape the electrodes of the spot welding gun. It removes spatter and restores the tip profile, ensuring consistent weld quality and extending electrode life. Integrated with the robot cycle, the tip dresser enhances productivity by maintaining optimal welding performance with minimal downtime

6. HMI (Human Machine Interface – 7" MTP):

The 7-inch MTP HMI allows users to easily select and execute welding programs. It provides a user-friendly interface to monitor system status, adjust basic settings, and access diagnostics. Operators can start or stop robot operations directly from the HMI, ensuring smooth and safe control of the arc welding process.

7. I/O Link Master:

An I/O-Link Master serves as the interface between a programmable logic controller (PLC) and I/O-Link-enabled devices such as sensors, actuators, and modules. It plays a pivotal role in modern robotics and automation by ensuring efficient communication, seamless integration, and enhanced functionality.

8. I/O Link Smart Light:

I/O-Link-enabled smart lights serve as advanced signalling devices in robotics and automation systems, providing real-time visual feedback, enhanced communication, and increased operational efficiency. Their integration with robots and PLCs makes them an indispensable tool for monitoring and managing industrial processes.

Table 1: Automated Welding Table

This automated welding table features a servo motor–based rotary arrangement for precise positioning during the spot welding process. It enables sequential welding on multiple sides without manual repositioning. The table includes toggle clamps for secure job mounting, ensuring accuracy and repeatability in automated welding operations

Automated Welding Table	Table with minimum dimensions of 1000 mm x 720mm
	Work surface made in aluminimum extrusions
	Servo Motor based rotary arrangement for automated spot welding process
	Servo Motor with minimum capacity of 200 W
	Planetary gear box with minimum raio of 9
	Inductive proximity sensor for servo motor referencing
	Toggle clamps for job mounting

Table 2: Horizontal Welding Table

Table 2 is designed for performing spot welding operations in a horizontal position. It includes a stable aluminum extrusion surface with toggle clamps to securely mount welding jobs. This setup is ideal for training or production tasks requiring flat, single-plane welding configurations.

Horizontal Welding Table	Table with minimum dimensions of 1000 mm x 720mm
	Work surface made in aluminimum extrusions
	Arrangement in aluminium extrusions of size 40mm x 40mm for mounting spot welding jobs in horizontal position
	Toggle clamps for job mounting

Table 3: Vertical Welding Table

Table 3 is designed for spot welding jobs in a vertical position, allowing users to simulate real-world welding orientations. It features a sturdy aluminum extrusion frame and toggle clamps for secure and accurate job mounting, enabling consistent weld quality in upright configurations.

Vertical Welding Table	Table with minimum dimensions of 1000 mm x 720mm
	Work surface made in aluminimum extrusions
	Arrangement in aluminium extrusions of size 40mm x 40mm for mounting spot welding jobs in vertical position
	Toggle clamps for job mounting

Table 4: Practice Table

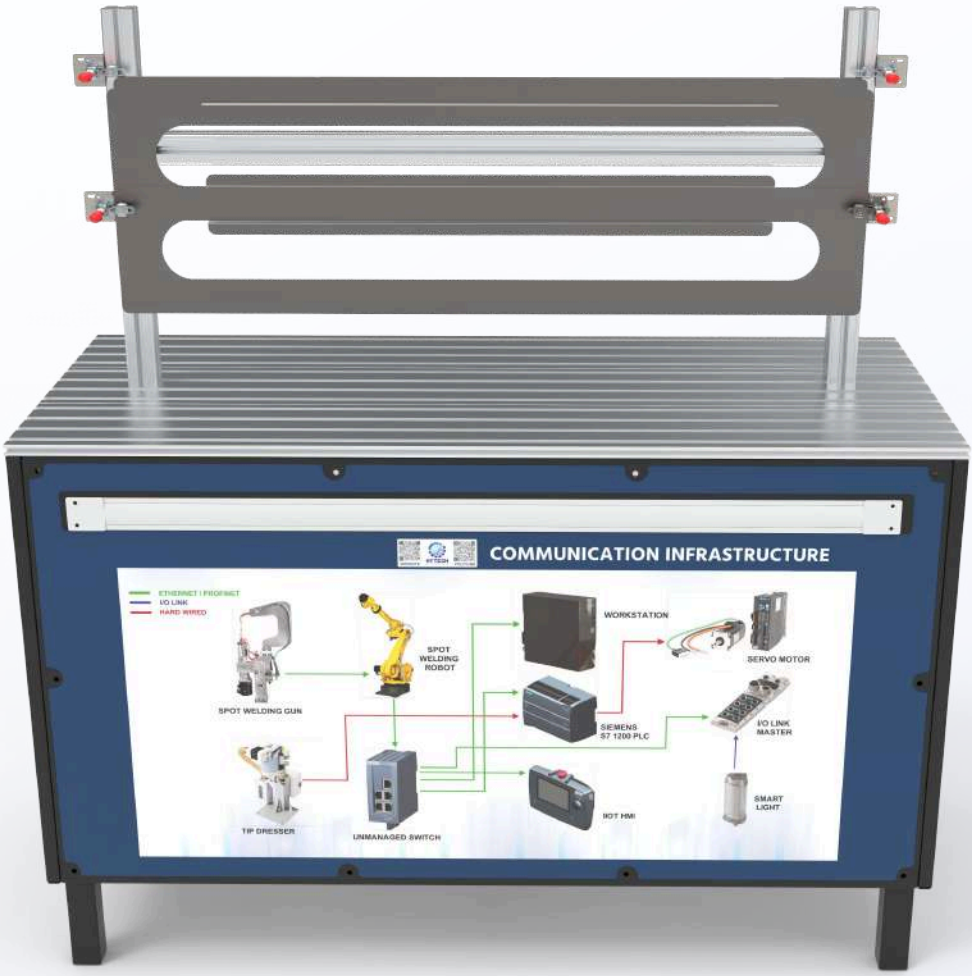


Table 4 is a versatile setup designed for practicing spot welding in both vertical and horizontal positions. It features a modular aluminum extrusion frame with toggle clamps to securely hold various job types. Ideal for training purposes, this table allows users to develop skills in multiple welding orientations.

Practice Table	Table with minimum dimensions of 1000 mm x 720mm
	Work surface made in aluminimum extrusions
	Arrangement in aluminium extrusions of size 40mm x 40mm for mounting spot welding jobs in vertical position as well as in horizontal position
	Toggle clamps for job mounting

Technical Specifications:

Robot	Fanuc R1000 Maximum Reach: 2230mm Maximum Payload: 130 KG Robot Weight: 675 KG Repeatability: +/- 0.03mm
Pedestal For Spot Welding Robot	Pedestal to mount the spot welding Robot manufactured in mild steel with total weight of minimum 165 KG. Chemical grouting arrangement for the pedestal.
SPOT Welding Gun	MFDC Servo Spot Gun MFDC Timer with Breaker Assembly Teach Pendant for SPOT Gun JC-ATD with cutter assembly (Tip Cleaning - Automatic PLC controlled)

Technical Specifications:

I/O Link Communication	I/O Link Master module with 8 ports of M12 connector
	I/O Link based Smart Light
Structure	Four Separate tables made in mild steel with work surface made in aluminium extrusions. Dimension of worksurface of each table is 1000 mm x 720mm
Controller And Water Tank Unit	Structure made in aluminium extrusions for housing Robot controller and Spot Welding gun controller with doors made in polycarbonate.
	Water recirculating tank with minimum capacity of 300 Ltr
	Tray with wheels for water tank
	Submerged water pump with minimum capacity of 1/2 HP
Central Control Unit	Separate Structure with CPU (i5) and Dual Monitors
	Hardware Operation Panel
	PLC: Siemens S7 1200 / Mitsubishi FX5
	HMI: 7 inch IIOT based HMI
	IIOT: 7 inch HMI with minimum 20,000 datapoints perpetual cloud space and remote screen control
	Connectivity: I/O Link based Profinet Connectivity
	I/O Link based Smart Light
Robot Operations	Fanuc / Robot OEM Teach Pendant
	Operation panel on welding controller for welding source
	Minimum 40 inch TV Screen to display Dynamic twin / teach pendant

Central Control Unit With PLC – HMI And IIOT

Centralized Control with PLC and HMI Integration

- The MIG Welding training cells feature a separate Central Control Unit comprising a PLC (Programmable Logic Controller) and HMI (Human-Machine Interface).
- Robots are seamlessly integrated with the PLC and HMI, enabling trainees to operate complete robotic cycles within an industrial automation context.
- This setup provides comprehensive exposure to industrial welding robotic architecture and hands-on experience with state-of-the-art robotics.

In modern manufacturing, robotic welding is rarely a standalone process. Instead, it functions as part of a larger, integrated automation system. Therefore, a training cell that includes PLC and HMI integration plays a critical role in preparing students and technicians for real industrial environments.

Importance Of PLC, HMI, And IIoT In Robotic Spot Welding Training

Training on robotic spot welding systems integrated with PLC, HMI, and IIoT transforms theoretical knowledge into practical, job-ready skills. It prepares learners to understand the full automation stack—from programming logic and user interfaces to data-driven manufacturing—making them capable of contributing to today's highly automated and connected production environments.

The Hytech Spot Welding Robotic Training Cell, coupled with PLC, HMI, and IIoT, provides the necessary education and hands-on experience aligned with current industry requirements, ensuring learners are equipped to meet the demands of modern smart manufacturing.

1. PLC – The Brain of the System

- Controls the entire workflow of the robotic welding cell
- Manages safety interlocks, sequencing, timing, and sensor integration
- Teaches learners how to develop logic for automation, synchronization, and fault handling
- Essential for real-time decision-making and integration with other plant equipment

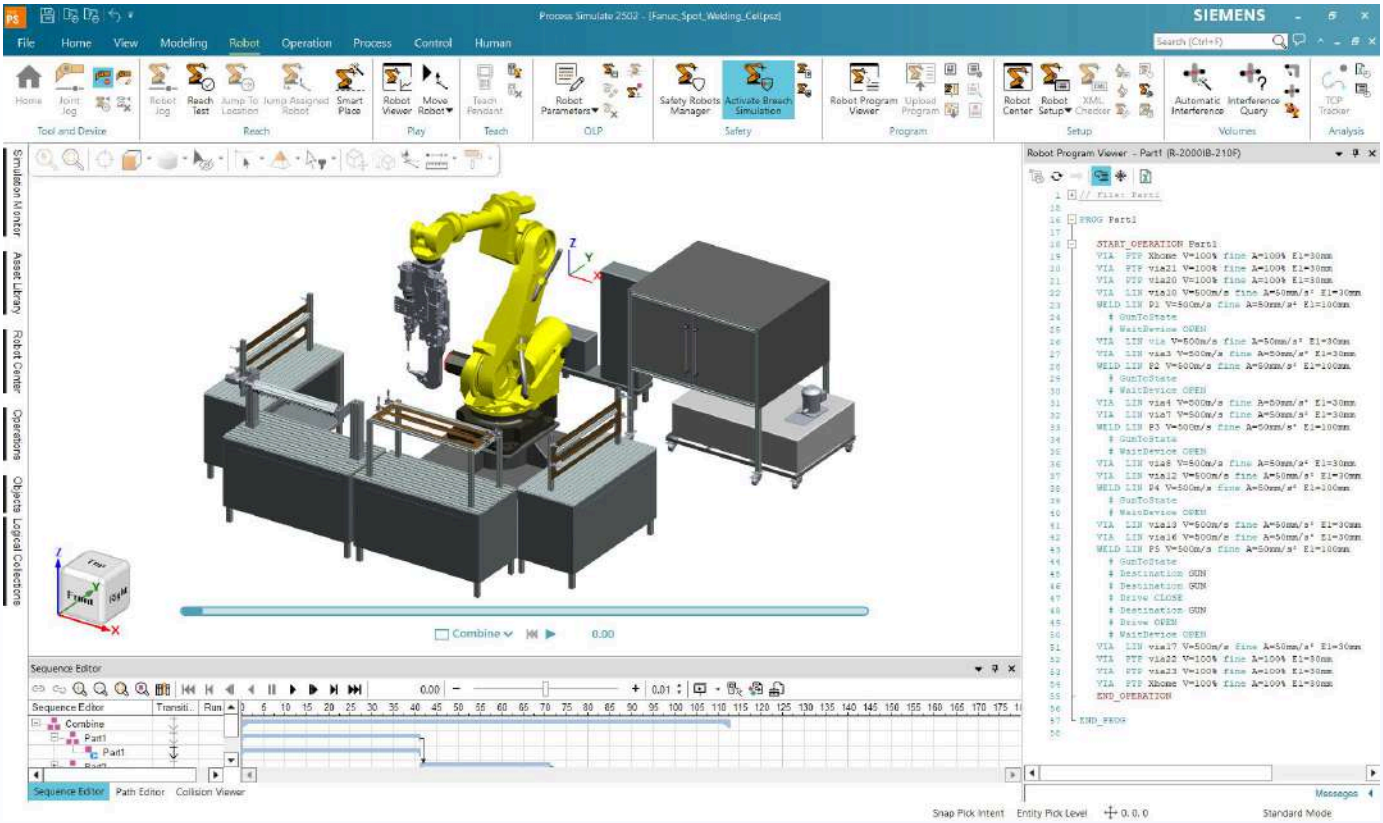
2. HMI – The Operator's Window

- Provides a user-friendly interface for controlling and monitoring the robotic cell
- Enables real-time visualization of welding parameters, cycle status, and system health
- Trains users to design and operate interactive dashboards for diagnostics and process control
- Helps simulate industrial SCADA and production line environments

4. IIOT & Industry 4.0 Readiness

- Allows connectivity between the robot, PLC, sensors, and external cloud or edge platforms
- Enables real-time data acquisition, remote monitoring, and predictive maintenance
- Facilitates analysis of welding data (current, voltage, cycle count, errors) for process optimization
- Prepares learners for smart factory roles aligned with Industry 4.0 standards

Importance Of Digital Twin And Offline Programming In Robotic Welding Training Cells



In modern technical education, robotic welding training cells are no longer just physical setups — they are platforms to teach smart manufacturing, automation, and Industry 4.0 concepts. Two critical components that elevate the effectiveness of these cells are Digital Twin and Offline Programming.

1. Safe & Realistic Skill Development

- A Digital Twin replicates the physical robot and welding process in a 3D virtual environment, allowing students to interact with the system without physical risks.
- Students can visualize and simulate welding paths, torch angles, and part positioning before executing real welds, making learning more engaging and mistake-tolerant.

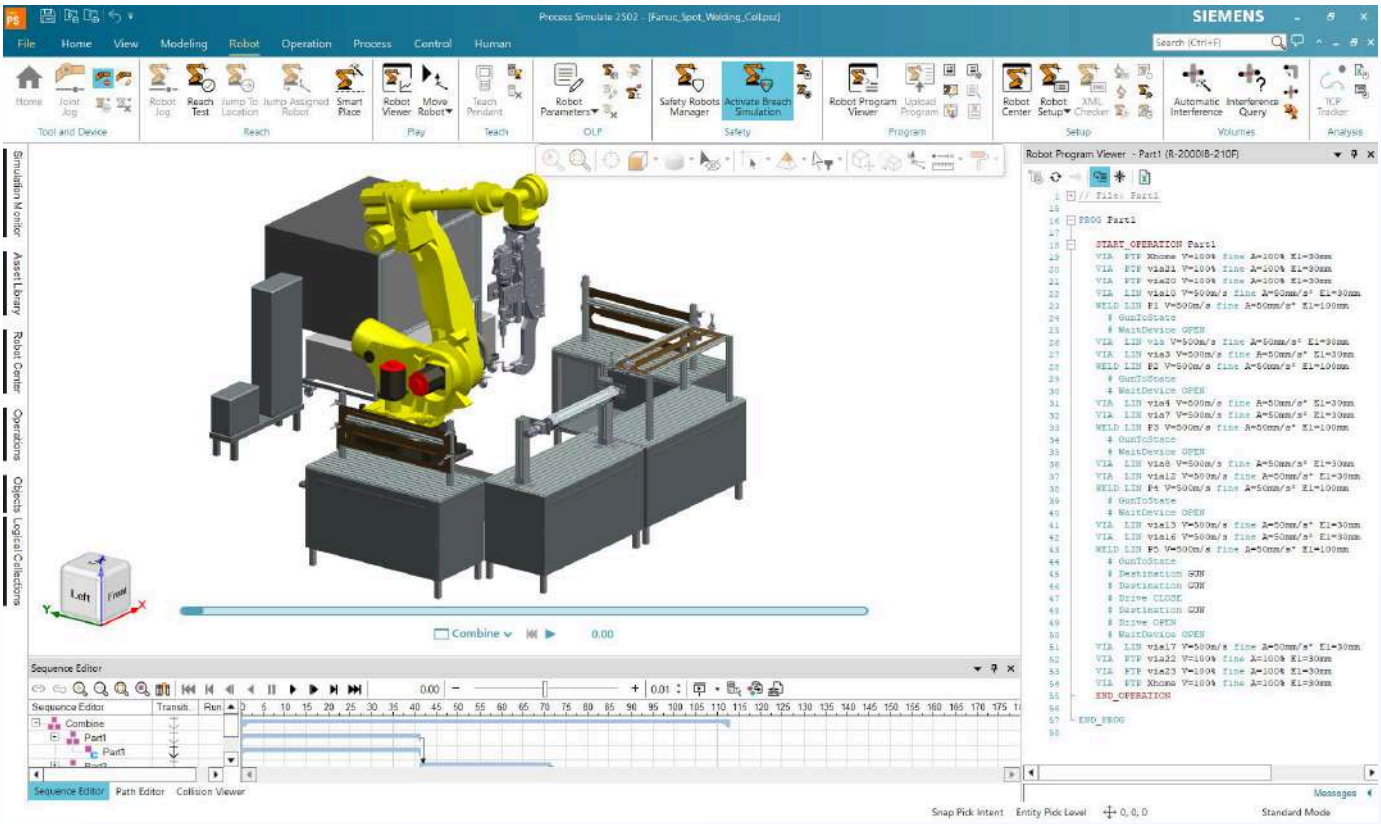
2. Offline Programming Builds Industry-Ready Skills

- With Offline Programming (OLP), trainees can learn how to write, test, and debug robot welding programs on a PC without interrupting ongoing operations.
- This mimics the way programming is done in actual factories, preparing students for real-world job roles in automation and robotics.

3. Minimizes Hardware Wear And Cost

- By using the digital model for training, hardware fatigue and consumable use are minimized, which reduces maintenance and operational costs in educational institutions.
- Reduces the need for repeated trial welds, saving on welding wire, gas, and base material.

Importance Of Digital Twin And Offline Programming In Robotic Welding Training Cells



4. Faster Learning With Real-Time Feedback

- The digital environment offers instant feedback on errors such as wrong weld paths, unreachable positions, or potential collisions.
- Enhances understanding of robot kinematics, joint limits, safety zones, and optimal weld sequences.

5. Bridges The Gap Between Simulation And Execution

- Once the program is tested and validated in the virtual twin, it can be directly uploaded to the real robot, helping learners understand how theory translates into practice.
- Encourages a project-based learning approach, where students can develop and demonstrate complete welding cycles digitally and physically.

6. Promotes Industry 4.0 Exposure

- Integration with IIOT, PLC, and smart sensors through the Digital Twin trains students in data-driven manufacturing.
- Students learn how to monitor performance, analyze digital signals, and implement predictive maintenance strategies — essential for smart factories.

Incorporating Digital Twin and Offline Programming into robotic welding training cells transforms them into next-generation skill development platforms. These technologies:

- Make learning safer and more effective
- Provide hands-on experience aligned with modern industry needs
- Reduce operational costs and downtime
- Equip students with tools used in actual industrial environments

Such training cells don't just teach welding — they teach the future of welding.

Spot Welding Robot Training Cell with Hytech Learning Management System

Spot welding robotics is an advanced and rapidly evolving field in industrial automation. Training of trainers is essential to ensure they are equipped to deliver effective and industry-relevant instruction. The Hytech Spot Welding Robot Training Cell comes integrated with a powerful Learning Management System (LMS) designed to elevate the training experience for both trainers and learners.

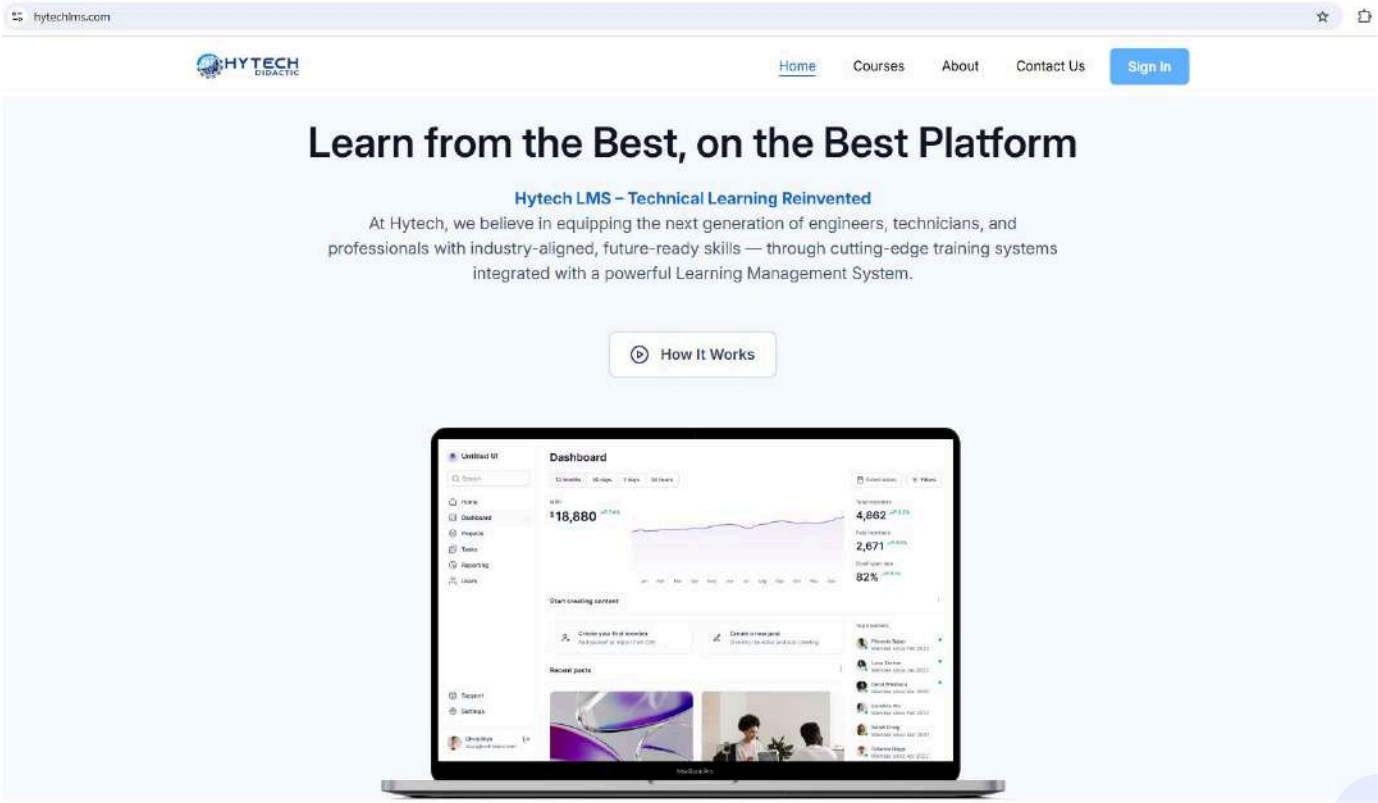
Key Features Of The Hytech LMS:

- **Step-By-Step Guidance:** Trainers receive structured, step-by-step instructions to master Spot welding robot operation, programming, and safety protocols.
- **Up-To-Date Training Content:** LMS content is regularly updated to reflect the latest trends and technologies in Spot robotic welding.
- **Customizable Content:** Trainers can develop custom modules, conduct online assessments, and issue digital certifications directly through the LMS platform.
- **Support For Management:** The LMS helps institutions manage trainer transitions, maintain consistent teaching quality, and provide continuous support and knowledge handover.

Spot Welding Robot Courses In The LMS:

The Hytech LMS offers in-depth courses combining theoretical fundamentals with practical, hands-on training focused on Spot welding automation. These courses empower trainers and students with the skills needed for real-world applications in robotic welding.

Contact us today for a free demonstration of the Hytech LMS and see how it can revolutionize Spot Welding Robot Training at your institution.



Spot Welding Robot Courses in the LMS:

Day 1	**Module 1: Introduction to Training Cell -** Introduction to Industrial Automation, Role of Robotics in Industrial Automation, Basics of Welding, Purpose of Spot Welding Robocell, Components of Robocell, Power Ratings & Electrical Connections	8 Hours
Day 2	**Module 2: Basic Electrical Wiring -** Electrical Wiring Symbols, Electrical Wiring Diagram, CCU Electrical & Field Wiring, PLC Electrical Wiring, PROFINET & Ethernet Communication, PLC–HMI–IO-Link–Robot Protocols	8 Hours
Day 3	**Module 3: PLC Design -** Introduction to PLC & TIA Software, Inputs & Outputs of PLC, Basic PLC Commands, Writing Basic PLC Programs	8 Hours
Day 4	**Module 3: (Cont'd) -** Timer Instructions, Counter Instructions, Practical Exercises on PLC Simulation	8 Hours
Day 5	**Module 4: PLC–HMI Integration -** PLC–HMI Communication Setup, Tag Mapping, I/O Mapping, Pneumatic Solenoid & Cylinder Control from HMI	8 Hours
Day 6	**Module 5: HMI Design -** Introduction to HMI, PI Studio Interface, Screen Designing, HMI Navigation & Feedback Display	8 Hours
Day 7	**Module 6: IO-Link Master Integration -** Introduction to HMI, PI Studio Interface, Screen Designing, HMI Navigation & Feedback Display	8 Hours
Day 8	**Module 7: Sensors -** Types of Sensors: Proximity, Reed, Pressure, Digital Sensor Integration, Analog Sensor Integration with PLC–HMI	8 Hours
Day 9	**Module 8: Servo Motor Control -** Servo Motor Basics, PLC Control of Servo, HMI Control of Servo, Referencing & Positioning Methods	8 Hours
Day 10	**Module 9: Welding Source -** Components of Welding Source, Teach Pendant Overview, Welding Parameters,Creating Welding Jobs	8 Hours
Day 11	**Module 10: Welding Source -** Components of Welding Source, Teach Pendant Overview, Welding Parameters,Creating Welding Jobs	8 Hours
Day 12	**Module 12: Integration -** Robot–Welding Source Integration, Robot–PLC–HMI Integration, PNS Program Selection, HMI-based Program Calling	8 Hours
Day 13	**Module 13: Robot Programming at Tables -** Vertical Fixture Table, Horizontal Fixture Table, Automated Fixture Table, Practice Fixture Table	8 Hours
Day 14	**Module 14: Advanced Applications & Safety Protocols -** Safety Standards in Welding Cells, Emergency Stop & Interlock Systems, Signal Interfacing between Robot & PLC, Best Practices in Robocell Maintenance	8 Hours
Day 15	**Module 15: Auto Tip Dresser (ATD) -** Introduction to ATD, Operation Workflow of ATD, PLC Connection Setup, Robot Programming for ATDAssessment & Review, Practical Evaluations, Viva & Feedback Collection	8 Hours

Thank You For Exploring Spot Welding by Hytech Didactic!

Stay Connected!

Follow us for Product Updates,
Training Videos and Expert Tips

www.hytechdidactic.com