This contest will be held at ECPI

ROBOTICS AND AUTOMATION TECHNOLOGY

PURPOSE

To evaluate each contestant's preparation for employment in the emerging arena of automation with emphasis on the team approach to problem-solving in a work environment. To recognize outstanding performance in the use of new work styles and technology by contestants.

First, download and review the General Regulations at: http://updates.skillsusa.org.

ELIGIBILITY (TEAM OF 2)

Open to active SkillsUSA members enrolled in programs with robotics, automation and/or manufacturing as the occupational objective.

CLOTHING REQUIREMENTS

Class C: Contest Specific — Manufacturing/Construction Khaki Attire

- Official SkillsUSA khaki short-sleeve work shirt and pants.
- Black, brown or tan leather work shoes.

Note: Safety glasses must have side shields or goggles (prescription glasses may be used only if they are equipped with side shields. If not, they must be covered with goggles).

These regulations refer to clothing items that are pictured and described at: www.skillsusastore.org. If you have questions about clothing or other logo items, call 800-401-1560 or 703-956-3723.

Note: Contestants must wear their official contest clothing to the contest orientation meeting.

EQUIPMENT AND MATERIALS

1. Supplied by technical committee:
   a. Necessary equipment including Siemens S7-1200 PLC trainer, proximity Sensors, SIMATIC HMI, connecting cables, and a computer with needed specifications.
2. All competitors must create a one-page résumé and submit a hard copy to the technical committee chair at orientation. Failure to do so will result in a 10-point penalty.

   ***Note*:** Your contest may also require a hard copy of your résumé as part of the actual contest. Check the Contest Guidelines and/or the updates page on the SkillsUSA website at http://updates.skillsusa.org.

Contestants are asked to check the Contest Updates page (http://updates.skillsusa.org) to see any applicable changes that apply to the task for that year.

Computer Specifications:

Each team will be supplied with a computer including all required software such as TIA Portal.

SCOPE OF THE CONTEST

1. Teams must be comprised of two students who will demonstrate their ability to compile and perform the skills and knowledge as determined by the technical committee.
2. The teams will be provided with a detailed description of the tasks and objectives required for an automated process.
   a. Setting up PLC and HMI for an automated process
      1. Establish and test communication between PLC and TIA portal
      2. Establish and test communication between HMI and TIA portal
      3. Connect proximity sensors to the PLC and test their behaviour
      4. Document all I/O connections for approval by judges
   b. Working with hand tools and integrating peripherals
      1. Wiring communication between PLC, HMI and computer
      2. Wiring communication between peripherals (sensors)
      3. Verify electronic connections using a multimeter
   c. Programming of PLC
      1. Determine sequencing and logic
      2. Determine input/output communication logic
      3. Develop logic diagram
      4. Write PLC program
      5. Design HMI interface

6. Link PLC tags to the HMI objects
7. Test the operation of the ladder program with HMI inputs as well as external inputs (like buttons and sensors)

Team Organization Goal

This is a team competition, and members may interact at will. The competition will be conducted as performed in industry. The operator will use the data to identify various kind of pucks (like non-metallic and/or metallic) and divert them to specific locations, and the programmers will tell the PLC exactly what is expected and when to perform specific functions. The number of parts will also be diaplayed on the HMI. The contest is designed to promote creativity in the organization of production responsibility.

All team members are responsible for double-checking each other's work and quality control.

Note: The judging criteria and the points assigned will be determined by the technical committee each year.

Knowledge Performance

The contest will include a written exam and oral presentation assessing competitors' knowledge of the principles of PLCs, proximity sensors, automation technology and safety practices.

Skill Performance

Students will work in teams of two from the same school to create a setup for an automated sorting process and monitor the process using HMI.

Contest Guidelines

1. Teams must be comprised of two students who will demonstrate their ability to compile and perform the skills and knowledge as determined by the technical committee.
2. Teams are given a task that they will solve using PLC, HMI and additional peripherals.
3. Each team will be required to provide documentation of its proposed methodlogy, based on the design criteria provided.
4. Teams will present the proposed method to the judges for approval and be given the go-ahead to implement their design.
5. Students will present their implemented method, including any changes to their original design.
6. The process will be judged based on hardware layout, wiring, power and external devices such as HMI, sensors.
7. The process will be fully functional with a program based on their original program design (flowchart). This will include the PLC ladder program, sensor data that tell the PLC exactly what is expected and when to perform specific functions; and monitoring the task using HMI
8. The contest is designed to mirror industry, promoting creativity using a standard design and organization of production responsibility. All team members are responsible for double-checking each other's work and quality control.
9. Contestants are required to adhere to industry safety standards using the hardware and software provided.
10. All equipment provided by the technical committee will be in place and set up on the Saturday before the competition begins.

Standards and Competencies

RAT 1.0 — Demonstrate knowledge in safety rules and practices

1.1 Maintain a safe work area
1.2 Demonstrate correct use of hand tools
1.3 Follow safety rules during installation and layout of HMI and sensors
1.4 Program PLC and HMI with appropriate use of safety devices

RAT 2.0 — Demonstrate ability to read and interpret electrical drawings

2.1 Interpret electric circuits used
2.2 Wire series electric circuits
2.3 Set up and operate DVM

RAT 3.0 — Produce examples of basic computer programming and flowcharting in a given scenario

3.1 Draw program flow chart using appropriate symbols representing the PLC ladder program
3.2 Develop basic computer program to control PLC, HMI and peripherals

RAT 4.0 — Demonstrate electrical sensor wiring

4.1 Adhere to electrical and safety standards
4.2 Use the appropriate hand tools and electrical wiring standards

4.3 Wire and connect different types of sensors used in a workcell, including capacitive and inductive proximity sensors

RAT 5.0 — Install and adjust any devices provided

5.1 Adhere to safety practices
5.2 Use the appropriate hand tools and electric wiring standards
5.3 Wire and connect sensors

RAT 6.0 — Create appropriate documentation used

6.1 Define and document all safety issues
6.2 Document and describe system layout
6.3 Describe and document controller input and output devices including peripheral device connections, input, output, program positions, wiring diagrams and system layout

RAT 7.0 — Write and verify PLC and HMI program

7.1 Develop a flowchart that outlines PLC program based on customer specifications
7.2 Design HMI screen based on customer specifications
7.3 Use variables and appropriate program remarks when developing ladder program
7.4 Design interfacing to input and output devices
7.5 Program various input and output devices
7.6 Demonstrate consideration for operation and maintenance of the system

Committee Identified Academic Skills

The technical committee has identified that the following academic skills are embedded in this contest.

Math Skills

- Use fractions to solve practical problems.
- Use proportions and ratios to solve practical problems.
- Simplify numerical expressions.
- Use scientific notation.
- Solve practical problems involving percentages.
- Solve single variable algebraic expressions.
- Solve multiple variable algebraic expressions.
- Measure angles.
- Apply transformations (rotate or turn, reflect or flip, translate or slide and dilate or scale) to geometric figures.
- Construct three-dimensional models.
- Make comparisons, predictions and inferences using graphs and charts.
- Organize and describe data using matrixes.
- Solve problems using proportions, formulas and functions.
- Use measures of interior and exterior angles of polygons to solve problems.
- Find arc length and the area of a sector.

Science Skills

- Plan and conduct a scientific investigation.
- Use knowledge of potential and kinetic energy.
- Use knowledge of mechanical, chemical and electrical energy.
- Use knowledge of heat, light and sound energy.
- Use knowledge of temperature scales, heat and heat transfer.
- Use knowledge of sound and technological applications of sound waves.
- Use knowledge of the nature and technological applications of light.
- Use knowledge of speed, velocity and acceleration.
- Use knowledge of Newton's laws of motion
- Use knowledge of work, force, mechanical advantage, efficiency and power.
- Use knowledge of principles of electricity and magnetism.
- Use knowledge of static electricity, current electricity and circuits.
- Use knowledge of magnetic fields and electromagnets.

Language Arts Skills

- Provide information in conversations and in group discussions.
- Provide information in oral presentations.
- Demonstrate use of such verbal communication skills as word choice, pitch, feeling, tone and voice.
- Demonstrate use of such nonverbal communication skills as eye contact, posture and gestures using interviewing techniques to gain information.
- Analyze mass media messages.
- Demonstrate comprehension of a variety of informational texts.
- Use text structures to aid comprehension.

- Identify words and phrases that signal an author's organizational pattern to aid comprehension.
- Understand source, viewpoint and purpose of texts.
- Organize and synthesize information for use in written and oral presentations.
- Demonstrate knowledge of appropriate reference materials.
- Use print, electronic databases and online resources to access information in books and articles.
- Demonstrate narrative writing.
- Demonstrate informational writing.
- Edit writing for correct grammar, capitalization, punctuation, spelling, sentence structure and paragraphing.

Connections to National Standards

State-level academic curriculum specialists identified the following connections to national academic standards.

Math Standards

- Numbers and operations.
- Algebra.
- Measurement.
- Problem solving.
- Reasoning and proof.
- Communication.
- Connections.
- Representation.

Source: NCTM Principles and Standards for School Mathematics. For more information, visit: http://www.nctm.org.

Science Standards

- Understands the sources and properties of energy.
- Understands forces and motion.
- Understands the nature of scientific inquiry.

Source: McREL compendium of national science standards. To view and search the compendium, visit: www2.mcrel.org/compendium/browse.asp.

Language Arts Standards

- Students adjust their use of spoken, written and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes.
- Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.
- Students use spoken, written and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion and the exchange of information).

Source: IRA/NCTE Standards for the English Language Arts. To view the standards, visit: www.ncte.org/standards.