SYSTEM CONTROL TECHNOLOGY

OVERVIEW

Applying leadership and 21st century skills, participants collaborate to develop a computer-controlled model-solution to a problem, typically one from an industrial setting. Teams analyze the problem, build a computer-controlled mechanical model, program the model, explain the program and mechanical features of the model-solution, and leave instructions for judges to operate the device.

ELIGIBILITY

One (1) team of three (3) individuals per state may participate.

TIME LIMITS

A. The competition consists of three (3) phases.
   1. Phase 1: The team's captain is given thirty (30) minutes to set up the team's equipment.
   2. Phase 2: Following the set-up time, teams are given fifteen (15) minutes for problem analysis.
   3. Phase 3: Following the problem analysis time, teams are provided two and one-half (2½) hours for model development and programming.

B. All students participate in an interview at the conclusion of their programming.

ATTIRE

TSA competition attire is required for this event.

PROCEDURE

A. Each team selects a team captain prior to the orientation meeting.

B. The team orientation meeting takes place at the beginning of the event at the conference.

C. The captain checks in the team within the set-up time by submitting his/her participant identification number and the team's identification number for the written and model portions of the event.

D. The problem and the inventor's log are presented to teams at the beginning of the fifteen (15)-minute problem analysis session prior to model-building.

E. Teams must complete their description or interpretation of the problem during this time.

F. Each team is given a maximum of two and one-half (2½) hours to:
   1. Construct a model that simulates realistic industrial processes
   2. Program the model
   3. Test the solution
   4. Describe the program and mechanical features of the model-solution
   5. Complete directions

G. When finished, teams save their programs and leave them on-screen in operable form with the ability to be reset.
   1. Before leaving the event room, teams demonstrate the operation of the model with judges present.
   2. The interview takes place directly after the demonstration. Judges may ask questions pertaining to the team's design and logical processes.
   3. After judges have observed the operation of a team's model, the team leaves the room.
   4. The coordinator determines the amount of time permitted for the team's demonstration based on the number of teams and the complexity of the problem.
   5. Evaluation of the solutions takes place without the teams present.

H. Judges independently assess the entries, including each team's interview responses.

I. The top ten (10) finalists are announced during the conference awards ceremony.

REGULATIONS AND REQUIREMENTS

Students will work to develop their leadership and 21st century skills in the process of preparing for and participating in this TSA competitive event. The development and application of those skills must be evident in their submission, demonstration, and/or communication pertaining to the entry.

A. No reference materials or building cards are allowed.

B. Participants provide their own laptop computer with hardware and software systems. All equipment must be labeled with the team's identification number, advisor name, and advisor contact information.

C. Each team provides pencils and scrap paper along with its own materials kit, which must be appropriate to build a system that can identify, secure, and move objects and that has light and/or sound outputs.

D. Teams design a solution to a problem based on the assumption that every materials kit contains at least:
   1. Two (2) optical sensors
   2. Two (2) touch sensors
   3. Two (2) motors
   4. Two (2) audio and two (2) light outputs
   5. Gears, wheels, and axles appropriate to build a motorized vehicle and/or conveyor belt
   6. Balls, blocks, and pegs that can be used as objects to be moved and manipulated
   7. Velcro, tape, clamps, and other materials to secure or move the above objects (balls, blocks, and pegs)
   8. No cutting devices may be used during the on-site challenge; materials must retain the original form in which they were brought to the competition.
   9. Power tools may not be used.

E. The following definitions are an integral part of the event regulations:
   1. Repeatability—the device is programmed to reset automatically.
   2. Functional control—the device/model must accomplish the task in an efficient manner and be user friendly.
   3. Model-solution—the physical device must simulate the realistic processes used in industry.
   4. Conservation of materials—the model reflects the best use of materials to solve the problem, without being overbuilt.

F. Programs must be written completely on-site.

G. Use or modification of any programs written prior to the competition will result in disqualification.

H. An example of a problem for this event is provided below to help students understand and interpret a typical issue common to industry that might be used at a national conference.

A manufacturing company has asked your engineering firm to design an important component in its manufacturing process. The company specializes in the production of cylindrical items. Its manufacturing line is getting "jammed" because multiple cylindrical items are making their way to stations that can handle only one item at a time. Your design must include a "hopper" that will store items as they wait to make their way to a station. When a station is empty, a light should turn on; this will indicate to an operator to press a button that will send one cylinder into the station. After ten (10) seconds, the item will need to be moved to the next hopper, leaving the station empty and signaling the operator to send in another cylinder.

Example Requirements

- A minimum of three (3) cylindrical items of consistent size and shape must be included.
- A hopper must store these items until a button is pushed.
- Only one item can advance when the button is pushed.
- Ten (10) seconds must pass with the item at a station before it is moved to the next hopper.
- A light must signal the operator when the station is empty.
- No additional cylinder can be sent to a station if a cylinder already is in place.

EVALUATION

A. The written work

B. The model function

C. The programming structure and efficiency

D. The interview

Refer to the official rating form for more information.

STEM INTEGRATION

This event aligns with the STEM (Science, Technology, Engineering, and Mathematics) educational standards.

LEADERSHIP AND 21ST CENTURY SKILLS DEVELOPMENT

This event provides opportunity for students to build and develop leadership and 21st century skills including but not limited to:

- Communication
- Collaboration/Social Skills
- Initiative
- Problem Solving/Risk Taking
- Critical Thinking
- Perseverance/Grit
- Creativity
- Relationship Building/Teamwork
- Dependability/Integrity
- Flexibility/Adaptability

CAREERS RELATED TO THIS EVENT

This competition has connections to one (1) or more of the careers below:

- CNC programmer
- Computer programmer
- Robotics engineer

SYSTEM CONTROL TECHNOLOGY INVENTOR'S LOG

TEAM CAPTAIN ID

Use only the space provided. The description/interpretation of the problem must be completed DURING the problem analysis session.

Description or interpretation of the given problem:

The two (2) parts below are to be completed AFTER the problem analysis session.

Description of the team solution (explain the unique features of the program and model):

Directions to evaluators to start the system:

Participant/Team ID# _____

SYSTEM CONTROL TECHNOLOGY

2021 & 2022 OFFICIAL RATING FORM

HIGH SCHOOL

Judges: Using minimal (1-4 points), adequate (5-8 points), or exemplary (9-10 points) performance levels as a guideline in the rating form, record the scores earned for the event criteria in the column spaces to the right. The X1 or X2 notation in the criteria column is a multiplier factor for determining the points earned. (Example: an "adequate" score of 7 for an X1 criterion = 7 points; an "adequate" score of 7 for an X2 criterion = 14 points.) A score of zero (0) is acceptable if the minimal performance for any criterion is not met.

Go/No Go Specifications

- Before judging the entry, ensure that the items below are present; indicate presence with a check mark in the box.
- If an item is missing, leave the box next to the item blank and place a check mark in the box labeled ENTRY NOT EVALUATED.
- If a check mark is placed in the ENTRY NOT EVALUATED box, the entry is not to be judged.

☐ Computer hardware is present
☐ Materials kit is present
☐ ENTRY NOT EVALUATED

INVENTOR'S LOG (20 points)				
CRITERIA	Minimal performance	Adequate performance	Exemplary performance	Record scores in the column spaces below.
	1-4 points	5-8 points	9-10 points	
Description of Problem (X1)	The description is incomplete, and/or it is illogical and unorganized; the description is simply a restatement of the problem's guidelines.	The description includes a logical, but only general, understanding of the problem's guidelines; it restates the guidelines with an overall understanding of the problem.	An organized, logical, and concise description of the problem is provided; it includes all major aspects of the problem's guidelines, as well as original thoughts.	
Description of Solution and Activation Instructions (X1)	The team's solution has little correlation with the final system creation; the solution is illogical in terms of the problem's guidelines; the directions to activate the solution are included, but they are incomplete.	The team's solution correlates generally with the final system creation; adequate directions to activate the solution are included.	A strong correlation between the team's written solution and final system creation is provided; the description of the solution is written clearly and concisely; instructions for the solution are included and written concisely.	
			INVENTOR'S LOG SUBTOTAL (20 points)	

SOLUTION TO PROBLEM (60 points)				
CRITERIA	Minimal performance	Adequate performance	Exemplary performance	Record scores in the column spaces below.
	1-4 points	5-8 points	9-10 points	
Realistic Simulation (X1)	The simulation is not realistic; it has an abstract design that would be largely ineffective in its intended environment.	The simulation is somewhat realistic and logically designed; it may be adequately effective in its intended environment.	The simulation is realistic and is similar to a system that would be effective in its intended environment.	
Dependability of Solution (X1)	The solution is not constructed with dependability in mind; when the system is operated, construction pieces fall off, etc.	Most of the parts of the solution are well constructed and dependable.	Every component of the solution is well constructed and dependable; practical construction techniques have been used.	

SOLUTION TO PROBLEM (60 points) – continued				
Conservation of Materials (X1)	An inefficient use of construction materials is obvious; too many unnecessary materials are incorporated into the design.	Most of the components of the solution are designed with conservation in mind; the construction is generally adequate.	All components of the solution are designed and assembled with conservation of materials in mind; the construction is elegant and not overbuilt.	
Solution to Problem (X2)	The solution is missing three (3) or more attributes/criteria, and several do not function as intended.	The solution includes most attributes/criteria, and they function adequately.	The solution includes all attributes/ criteria listed in the design details, and all attributes function appropriately and correctly.	
Ingenuity and Creativity (X1)	The solution and design are unauthentic, complex, and/or do not function as a system.	The solution has some original ideas in its design, and its construction is adequate.	The solution is truly unique and authentic; its construction is concise and designed with simplicity.	
			SOLUTION TO PROBLEM SUBTOTAL (60 points)	

PROGRAMMING STRUCTURE (20 points)				Record scores in the column spaces below.
CRITERIA	Minimal performance	Adequate performance	Exemplary performance	
	1-4 points	5-8 points	9-10 points	
Programming Efficiency (X1)	The software used to program the system is overly complex and inefficient; advanced programming techniques, which would have simplified programming specific tasks, are not included.	The programming software is efficient, with some advanced features that simplify the solution's criteria and/or attributes.	A concise and logical programming application is used that incorporates advanced features to simplify the solution's criteria and/or attributes.	
Program Structure (X1)	The programming structure is illogical, unorganized, or overly complicated and/or complex; the program does not reset.	There is evidence of an organized programming structure and adequate use of sub-routines; the program resets.	The programming structure is concise and predictable; there is appropriate use of sub-routines where needed; the program resets.	
			PROGRAMMING STRUCTURE SUBTOTAL (20 points)	

Rules violations (a deduction of 20% of the total possible points for the above sections) must be initialed by the judge, coordinator, and manager of the event. Record the deduction in the space to the right.

Indicate the rule violated: _____

DEMONSTRATION/INTERVIEW (10 points)				Record scores in the column spaces below.
CRITERIA	Minimal performance	Adequate performance	Exemplary performance	
	1-4 points	5-8 points	9-10 points	
Articulation (X1)	Communication of the design process is unclear, unorganized, and or illogical; leadership and/or 21st century skills are not evident.	Communication of the design process is somewhat logical and clear; leadership and/or 21st century skills are somewhat evident.	Communication of the design process is clear, concise, and logical; leadership and/or 21st century skills are clearly evident.	
			DEMONSTRATION/INTERVIEW SUBTOTAL (10 points)	

Rules violations (a deduction of 20% of the total possible points for the above sections) must be initialed by the judge, coordinator, and manager of the event. Record the deduction in the space to the right. Indicate the rule violated: _____	
SUBTOTAL (10 points)	
To arrive at the TOTAL score, add any subtotals and subtract rules violation points, as necessary. **TOTAL** (110 points)	

Comments:

I certify these results to be true and accurate to the best of my knowledge.

JUDGE

Printed name: _____ Signature: _____

SYSTEM CONTROL TECHNOLOGY EVENT COORDINATOR INSTRUCTIONS

PERSONNEL

A. Event coordinator

B. Judges, two (2) or more

C. Assistants, two (2)

MATERIALS

A. Coordinator's packet, containing:

1. Event guidelines, one (1) copy for the coordinator and for each judge
2. TSA Event Coordinator Report
3. List of evaluators/assistants
4. Stopwatch, one (1)
5. Written problem, one (1) copy per team and judge
6. Inventor's Log, one (1) copy per team
7. Power strips with surge protectors, and extension cords, as needed
8. Results envelope

B. Large room to accommodate a first place team from every state and affiliated country

C. One (1) table and three (3) chairs per team

RESPONSIBILITIES

AT THE CONFERENCE

A. Attend the mandatory coordinator's meeting at the designated time and location.

B. Report to the CRC room and check the contents of the coordinator's packet.

C. Review the event guidelines and check to see that enough personnel have been scheduled.

D. Inspect the area(s) in which the event is being held for appropriate set-up, including room size, chairs, tables, outlets, etc. Notify the event manager of any potential problems.

E. At least one (1) hour before the event is scheduled to begin, meet with judges/assistants to distribute materials and to review time limits, procedures, regulations, evaluation, and all other details related to the event. If questions arise that cannot be answered, speak to the event manager before the event begins.

EVENT CHECK-IN

A. Begin the event at the scheduled time by closing the doors.

B. All participants and judges should be in the room at this time.

C. Late entries are considered on a case-by-case basis and only when the delay is caused by events beyond participant control.

D. In order to compete, participants must be on the entry list or have approval of the CRC.

E. Secure participants' equipment in the area designated.

PRELIMINARY ROUND

A. At the orientation meeting obtain the team/chapter identification numbers from each team captain.

1. Judges must be present at the orientation meeting.
2. Review the time limits, procedure, and regulations with team captains.

B. Distribute the problem and Inventor's Log to teams at the beginning of the event.

C. Teams have fifteen (15) minutes to complete their interpretation of the problem in the Inventor's Log.

D. Each team is given two and one-half (2½) hours to complete the remaining portions of the event.

E. Teams must demonstrate that their device/model is operable and has the ability to reset prior to leaving.

1. Judges must observe this portion and shall ask a few questions.
2. Judges may take notes, but evaluation occurs only after all teams have left the event room.

F. Decisions about rules violations must be discussed and verified with the judges, event coordinator, and CRC manager to determine either:

1. To deduct 20% of the total possible points or
2. To disqualify the entry

The event coordinator, judges, and CRC manager must initial either of these actions on the rating form.

G. Judges determine the top ten (10) finalists and discuss and break any ties.

H. Submit the finalist results and all related forms in the results envelope to the CRC room.

I. If necessary, manage security and the removal of materials from the event area.