SYSTEM CONTROL TECHNOLOGY

OVERVIEW

Participants work as part of a team onsite 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) members per state may participate, one (1) entry per team.

TIME LIMITS

1. The competition consists of three phases.
   a. Phase 1: one (1)-hour setup
   b. Phase 2: fifteen (15)-minute analysis
   c. Phase 3: two and one half (2.5) hours for problem solution
2. The team's captain will be given one (1) hour to set up the team's equipment and reference materials.
3. Following the set-up time, teams will be given fifteen (15) minutes for problem analysis.
4. Following the problem analysis time, teams are provided two and one-half (2.5) hours for model development and programming.
5. All students will participate in a LEAP and problem solution interview at the conclusion of their programming.

LEAP

A team LEAP Report is required for this event and must be submitted at event check-in (see LEAP Program).

ATTIRE

TSA competition attire is required for this event.

PROCEDURE

PRELIMINARY ROUND

1. An orientation meeting for teams will take place at the beginning of the set-up time. Each team selects a team captain prior to the orientation meeting.
2. The captain checks in and submits a LEAP Report for the team during the set-up time meeting by submitting his/her participant identification number and the team's identification number for the written and model portions of the event.
3. 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. Teams must complete their description or interpretation of the problem during this time.
4. Each team is given a maximum of two and one-half (2½) hours to construct a model that simulates realistic industrial processes to program the model, to test the solution, to describe the program and mechanical features of the model-solution, and to complete directions for judges to use to activate the model.
5. When finished, teams save their programs and leave them on-screen in operable form with the ability to be reset.
   a. Before leaving the event room, teams demonstrate the operation of the model with judges present. Judges may ask questions during the demonstration.
   b. After judges have observed the operation of a team's model, the team leaves the room. 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.
   c. Evaluation of the solutions takes place without the teams present.
6. Team members will participate in an onsite LEAP interview during the project demonstration period.
7. Judges independently assess the entries, including each team's LEAP Report.

8. The top ten (10) finalists will be announced during the conference awards ceremony.

REGULATIONS

PRELIMINARY ROUND

A. Each team provides pencils and scrap paper along with its own materials kit, software, and laptop computer.

B. No reference materials or building cards are allowed.

C. Each team's material kit must be appropriate to build a system that can identify, secure, and move objects, and has light and/or sound outputs.

D. A problem will be developed based on the assumption that every material kit will contain at least:

1. Optical sensors, two (2)
2. Touch sensors, two (2)
3. Motors, two (2)
4. Audio AND light outputs, two (2) each
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)

E. Participants provide their own hardware and software systems.

F. 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.

G. Programs must be written completely onsite. **Use or modification of any programs written prior to the competition will result in disqualification.**

Example Problem

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.

H. The LEAP Report

1. Teams document the leadership skills developed and demonstrated while working on this event, and on a non-competitive event leadership experience.
2. Teams will respond to questions about the content of the LEAP Report as part of the semifinalist LEAP interview.
3. Specific LEAP Report regulations can be found in the LEAP Program section of this guide and on the TSA website.

EVALUATION

PRELIMINARY ROUND

1. The team's written work
2. Model function
3. Programming structure and efficiency
4. The content and quality of the LEAP Report and interview

Refer to the official rating form for more information.

STEM INTEGRATION

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

CAREERS RELATED TO THIS EVENT

- 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 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

2019 & 2020 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.

☐ Completed LEAP Report 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 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: _____

PRELIMINARY SUBTOTAL (100 points)

LEAP 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	
LEAP Report/ Interview (10% of total event points)	The team's efforts are not clearly communicated, lack detail, and/ or are unconvincing; few, if any, attempts are made to identify and/or incorporate the SLC Practices and Behaviors.	The team's efforts are adequately communicated, include some detail, are clear, and/or are generally convincing; identification and/or incorporation of the SLC Practices and Behaviors is adequate.	The team's efforts are clearly communicated, fully-detailed, and convincing; identification and/or incorporation of the SLC Practices and Behaviors is excellent.	
			LEAP 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: _____	
SEMIFINAL 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

1. Preliminary round, two (2) or more
2. Semifinal round, 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. Pre-populated flash drives for judges
5. Stopwatch, one (1)
6. Written problem, one (1) copy per team and judge
7. Inventor's log, one (1) copy per team
8. Power strips with surge protectors, and extension cords, as needed
9. Results envelope
10. Envelope for LEAP Reports
11. LEAP Interview Judging Protocol

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

1. Attend the mandatory coordinator's meeting at the designated time and location.
2. Report to the CRC room and obtain the coordinator's packet; check the contents.
3. Review the event guidelines and check to see that enough judges/assistants have been scheduled.
4. 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.
5. 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, and regulations. If questions arise that cannot be answered, speak to the event manager before the event begins.

EVENT CHECK-IN

1. Begin the event at the scheduled time by closing the doors, checking the entry list, and collecting LEAP Reports from each team.
2. All participants and judges should be in the room at this time.
3. Anyone reporting who is not on the entry list may check in only after official notification is received from the CRC.
4. Late entries are considered on a case-by-case basis and only when the delay is caused by events beyond participant control.
5. Secure participants' equipment in the area designated.

PRELIMINARY ROUND

1. At the orientation meeting obtain the team/chapter identification numbers from each team captain.
2. Judges must be present at the orientation meeting.
3. Review the time limits, procedure, and regulations with team captains.
4. Distribute the problem and *Inventor's Log* to teams at the beginning of the event.
5. Teams have fifteen (15) minutes to complete their interpretation of the problem in the Inventor's Log.
6. Each team is given two and one-half (2½) hours to complete the remaining portions of the event.

7. Teams must demonstrate that their device/model is operable and has the ability to reset prior to leaving.
    a. Judges must observe this portion and may ask a few questions.
    b. Judges may take notes, but evaluation occurs only after all teams have left the event room.
8. The LEAP interview will last a maximum of five (5) minutes.
9. Decisions about rules violations must be discussed and verified with the judges, event coordinator, and CRC manager to determine either:
    a. To deduct 20% of the total possible points or
    b. To disqualify the entry
    c. The event coordinator, judges, and CRC manager must all initial either of these actions on the rating form.
10. Judges determine the top ten (10) finalists in rank order, and discuss and break any ties. (Determine the procedure for breaking ties before the onsite competition begins.)
11. Review and submit the finalist results and all related items/forms in the results envelope to the CRC room for posting.