THOMPSON RIVERS UNIVERSITY

Department of Engineering

Acres Innovation Competition 2024

acres

Innovate today,
build tomorrow

SUSTAINABLE DEVELOPMENT GOALS

1 Objective

The objective of the competition is to solve a real world, business problem. The goal is to encourage students to produce a feasible design despite limited materials and preparation time. Engineers are often required to think quickly to produce a working solution given limited resources. Competitors combine teamwork and problem-solving skills to design, construct, test, and present a previously undisclosed project.

1.1 Acres Enterprises

Acres Enterprises is a locally owned and operated company in Kamloops, B.C. with an over 40-year history in general, industrial, and civil construction. Acres' work extends from the interior to the northern regions of the province. We work in partnership with our clients and are driven by our commitment to quality. We are unique in that, as a concept-to-completion company, we deliver excellence through the cutting-edge use of technology, including fully automated equipment and the use of GPS technology drones.

Acres provides quality work throughout BC with a focus on what we are leaving for the next generation. Our quality builds will stand the test of time. We have built relationships within the community that allow us to contribute to the progressive development of our community. Our commitment to excellence today and in the future means that we are actively involved in bettering our community—scholarships, sponsorships, volunteering, and our involvement with several community associations are just some examples of how we demonstrate integrity, commitment, and dedication to our team and to our community.

Our family-like work culture sets us apart and has allowed us to develop a highly qualified, diversified team of professionals who are committed to delivering excellence at every step of the project. We pride ourselves on our impeccable track record of delivering on time and on budget through hard work, sensitivity to our clients' needs, and professional dedication to our projects and clientele. Our innovative solutions and professional services ensure that our work is of the highest standard to not only meet but exceed our clients' expectations.

Mission – We strive to achieve the highest standard of construction while continually exceeding our clients' expectations. Strong relationships with partners and clients are vital to our organization's success, and we value integrity and fairness in all our business dealings.

Vision -– We are a talented team of diversified, tech-savvy, construction professionals who continually challenge the status quo. We innovate around traditional challenges to create opportunities, leveraging new technologies to achieve continuous advances in construction practices.

Values – Core values are our Acres rules that we live by –the fundamental values exercised by our employees, personally and professionally. We are Ambitious, Competent, Respectful, Engaged, and Supportive (ACRES). These values are reflected in our business practices, our partners we work with, and our involvement in the communities we are privileged to work and live in.

1.2 UN Sustainable Development Goals

"The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals, which are an urgent call for action by all countries - developed and developing - in a global partnership. They recognize that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth - all while tackling climate change and working to preserve our oceans and forests."

`https://sdgs.un.org/goals`

2 Awards

2.1 Acres Enterprises Technology Excellence Award ($4000)

This award recognizes the winners of the Acres Enterprises Industry Innovation Competition. The ideal candidates for this award show a passion for technology and innovation, and a willingness to go above and beyond to solve problems at hand. Mentorship and potential work-placement opportunities at Acres Enterprises are offered as part of the awards. Award amount will be split evenly amongst winning team.

SWAG

Additional prizes will be handed out to the second and third place teams (no monetary value).

3 Eligibility

3.1 General

- Maximum team size of 5 Students

3.2 Acres Enterprises Technology Excellence Award

- Maximum of 10 teams.
- Current undergraduate student at TRU in Computer Science or Software Engineering

3.3 Waivers

To be eligible every team must sign a release to Acres to use the solution as part of their business at the present or in the future.

4 Facilities Provided by the Organizing Committee

- Materials for assembly of the prototype
- List of provided materials. (See Appendix – Table 2)

5 Facilities Provided by the Competitors

- Student owned computers/laptops are permitted.
- Materials from the “approved” materials list. (See Appendix – Table 3)

6 Competition Personnel

- Each team will be appointed one faculty member from TRU.
- Each team will be appointed one business consultant from Acres.
- Judges
  - One head judge from TRU - Department of Engineering
  - Two judge from Acres Enterprises (Jason Paige and Chad Kyllo)
  - One judge from TRU - Department of Computing Science
  - One judge external to Acres and TRU

7 Topic Selection

Every group is free to choice a topic related to any of the 17 UN Sustainable Development, however, it must be applied to the construction sector. The prototype should help solve a real world issue related to construction; and it should include a sensor, data acquisition, and a software frontend. The topic must be difficult enough to challenge junior engineering students, while being reasonable to produce a physical prototype within the allotted time. Use of general engineering principles should be needed for the design, but competitors should not be expected to use senior course level knowledge. A good topic will give teams the opportunity to use novel ideas and allows for multiple design possibilities. Topics must be fully documented in writing. All necessary documentation must be provided to competitors and judges when the problem is presented. All restrictions/constraints will also be noted.

8 Competitor Deliverables

Teams are required to design, construct, and test their project during the limited time provided in the first half of the competition. During the rest period each group must:

- write a report,
- record a video demonstration, and
- prepare an oral presentation

that demonstrates their design. The report should follow the provided template and be a maximum of 10 pages. The oral presentation should summarize the design process, the design itself, and any unique aspects of the design to the judges and the general public. During the oral presentation, the team must demonstrate the design to show how well it meets the requirements of the project. Each presentation can be a maximum of twenty minutes followed by ten minutes of questions. The demonstration video will be a maximum of 5 minutes long.

9 Judging

The most important aspects of evaluation in this category are the design and performance, business objective, teamwork, and the quality of the presentation. The organizing committee should select judges that have appropriate experience in a range of disciplines. An odd number of judges must be used, preferably five (5), although three (3) is a minimum in any given panel. Multiple panels of judges may be used when required. Judges deliberation will be conducted privately, and the results will not be released until the awards presentation. A feedback form from the judges will be compiled for each team and delivered to the teams individually.

10 Scoring

Each project will be judged in four areas: "Problem Analysis", "Project Demo", "Engineering Design Process", and "Oral Presentation". A rubric for how each area will be judged is given in Table 4, 5, 7, and 8. The score will then be totaled on the scoring sheet in Table 9. Every group's final score will be the average of the judges total score.

11 Competition Procedures / Timeline

The competition is divided into three phases:

- Phase 1: Question Period
  (Septemeber 1st – 30th, 2024)
- Phase 2: Development of the Solution and Preparation of Deliverables
  (October 1st – November 30th, 2024)
- Phase 3: Final Presentations
  (November 30th, 2024)

It is suggested that each group should meet (virtually) with their faculty advisor and the Acres business consultant once per week during Phase 2. Each Faculty advisor will be available to meet with their group for a minimum of thirty minutes per week at a time convenient to both the team and the advisor. The business consultant from Acres will be available for all teams for a minimum of one hour per week.

11.1 Important Dates

- 2024-09-01 – Problem Statement Released and Registration Opens
- 2024-09-26 – Kick-Off Meeting
- 2024-10-01 – Registration Closes
- 2024-11-28 – Project Report and Demonstration Video Due
- 2024-11-30 – Final Presentations

Appendix

Item	Sub-Item	Quantity
MEGA 2560 Start Kit	Mega 2560 Controller Board	1
	USB Cable	1
	Breadboard	1
	Prototype Expansion Module	1
	Power Supply Module	1
	GY-521 Module	1
	IC 74HC595	1
	LCD1602	1
	RC522 RFID Module	1
	IR Reciver Module	1
	HC-SR501 PIR Motion Sensor Module	1
	Sound Sensor Module	1
	Water Level Detection Sensor Module	1
	Ultrasonic Sensor Module	1
	DS1037 RTC Module	1
	Rotary Encoder Module	1
	DHT11 Temperature and Humidity Module	1
	IR Receiver Module	1
	Joystick Module	1
	Remote Control	1
	MAX7219 Module	1
	1 Digit 7-Segment Displays	1
	4 Digit 7-Segment Displays	1
	L293D	1
	Potentiometer 10K	1
	5V Relay	1
	Membrane Switch Module	1
	9V Battery with Connector Clip	1
	9V1A Adapter	1
	Active Buzzers	1
	Passive Buzzers	1
	Tilt Switch	1
	Photo resistor	1
	LEDs	21
	Button	5
	Servo Motor SG90	1
	Stepper Motor	1
	Fan Blade and 3-6V Motor	1
	ULN2003 Stepper Motor Driver Module	1
	Thermistor	1
	Diode Rectifier	5
	Various Resistors	100
	Various Capacitors	14
	Various Transistors	10
	Various Wires	-

Table 1: List of Provided Materials

Item	Sub-Item	Quantity
Sensor Kit	Joystick Module	1
	Relay Module	1
	Rotary Encoder Module	1
	DS-1307 RTC Module	1
	Ultrasonic Sensor Module	1
	HC-SR501 PIR sensor Module	1
	Flame Sensor Module	1
	Linear Hall Module	1
	Metal Touch Module	1
	Digital Temperature Module	1
	Big Sound Module	1
	Small Sound Module	1
	RGB LED Module	1
	SMD RGB Module	1
	Two-tone Color Module	1
	7 Color Flash Module	1
	Laser Emit Module	1
	Shake Module	1
	IR Receiver Module	1
	IR Emission Module	1
	Tilt Switch Module	1
	Button Module	1
	Active Buzzer Module	1
	Passive Buzzer Module	1
	18B20 temp Module	1
	Photo-resistor Module	1
	Temperature and Humidity Module	1
	GY-521 Module	1
	Photo-interrupter Module	1
	Tap Module	1
	Membrane Switch Module	1
	Avoidance Module	1
	Tracking Module	1
	Magnetic Spring Module	1
	Water Lever Sensor	1
	Power Supply Module	1
	LCD1602 Module	1

Table 2: List of Provided Materials (Continuted)

Item	Maximum Quantity
Any Version Arduino	3
Any Version Raspberry Pi	3
Any Sensor on the list of provided Material	3
Wire	∞
Any Breadboards	∞
Construction Material	∞

Table 3: List of Approved Materials

	Outstanding (93-100 point)	**Excellent (80-92 points)**	**Good (68-79 points)**	**Satisfactory (50-67 points)**	**Unsatisfactory (0-49 points)**
Complexity of the problem	Project involves technical analysis for 4 or more subsystems	Project involves technical analysis for 3 subsystems	Project involves technical analysis for 2 subsystems	Project involves technical analysis for 1 subsystem	Project involves no technical analysis
Depth and Breadth of Problem analysis	Meaningful technical analysis is extensive and relevant in every sense; all aspects of the design are analyzed	Meaningful technical analysis is broad and included for all important aspects of the design and most minor aspects of the design	Meaningful technical analysis included for multiple important aspects of the design	Meaningful technical analysis included for one important aspect of the design or several minor aspects of the design	Technical analysis is missing, minimal, incomprehensible, superficial, trivial, or irrelevant or has major errors; or the design decisions and design are not amenable to technical analysis
Level of knowledge used	Technical analysis clearly uses substantial fourth-year technical knowledge	Technical analysis clearly uses substantial third-year technical knowledge	Technical analysis arguably uses substantial third-year technical knowledge	Technical analysis clearly uses substantial second-year technical knowledge	Technical analysis is missing, minimal, incomprehensible, superficial, trivial, or irrelevant or has major errors;

Table 4: Problem Analysis Rubric

	Outstanding (93-100 point)	**Excellent (80-92 points)**	**Good (68-79 points)**	**Satisfactory (50-67 points)**	**Unsatisfactory (0-49 points)**
Completeness	Beyond required expectations	Shows all the required functionalities	Shows most of the required functionalities	Absence of some of the critically required functionalities	Absence of most of the required functionalities

Table 5: Project Demo Rubric

Criteria	Weight	Grade (10)	Weighted Grade
Problem Definition and Project Scope The presentation must clearly and correctly identify and define the problem requirements, and design constraints. The objectives and scope of the project should be clear.	1.5		
Design Methodology The presentation must demonstrate the use of appropriate engineering design methodology. A minimum of three viable alternatives that met the engineering specifications must have been considered and evaluated before selecting a final design solution. Nontechnical issues such as environmental impact, safety, legal requirements, etc. are considered as appropriate.	1.5		
Design Solution The proposed design solution is clearly described along with engineering-based rationale that led to its selection from the possible solutions.	2.0		
Presentation Materials Presentation materials must be organized, visually appealing, and effective in supporting the oral presentation. Text must be legible and graphics must be relevant and of high quality.	1.5		
Delivery The team should be organized and well rehearsed. Delivery should be polished and professional. Each speaker should display proper eye contact and body language. Words should be spoken clearly at a suitable volume. The allotted time should be used effectively.	1.5		
Questions The team must answer questions succinctly and coherently. Answers must demonstrate knowledge and insightful understanding of the project and related issues.	2.0		
Total	10	/60	/100

Table 6: Oral Presentation Evaluation Rubric

Criteria	Weight	Grade (10)	Weighted Grade
Uniqueness in idea The idea should be new and novel to the construction industry.	5		
Impact on the industry If the idea were to be fully implemented it should have a large and immediate impact on the construction industry.	5		
Total	10	/20	/100

Table 7: Real World Business Problem Evaluation Rubric

	Outstanding (93-100 point)	Excellent (80-92 points)	Good (68-79 points)	Satisfactory (50-67 points)	Unsatisfactory (0-49 points)
Complexity of design task	Project involves the open-ended design of 4 or more subsystems	Project involves the open-ended design of 3 subsystems	Project involves the open-ended design of 2 subsystems	Project involves the open-ended design of 1 subsystem	Project involves no open-ended design
Quality of final design	Design is convincingly shown to meet project objective and satisfy all specifications; creative; novel; a truly great accomplishment	Design is shown to meet project objective and satisfy all essential specifications, some creativity; some originality; an excellent design	Design is shown to meet project objective and satisfy most of the essential specifications; some reflection of novelty, or creativity; a good design	Design arguably meets project objective and satisfies essential specifications; some key details are missing; adequate design	Design is not shown to meet the project objective and do not satisfies specifications; most of the key details are missing; inadequate design
Level of detail of final design	Complete details provided for all aspects of the final design; excellent visual representation; excellent modular illustration;	Complete details provided for all major and most minor aspects of the final design; good visual representation; good modular illustration;	Good amount of details provided for all major aspects of the final design; reasonable visual representation; reasonable modular illustration;	Some details provided for almost all major aspects of the final design; poor visual representation; poor modular illustration;	Almost no details, or details are incomprehensible, for major aspects of the design; no visual representation; no modular illustration;
Use of engineering design process	A reasonable solution is proposed; thorough investigation of serious alternatives and/or iterations; design process is clearly systematic, comprehensive, and substantial	A reasonable solution is proposed; investigation of serious alternatives and/or iterations; design process is clearly systematic and comprehensive, and arguably substantial	A reasonable solution is proposed; investigation of serious alternatives and/or iterations; design process is systematic and comprehensive	A reasonable solution is proposed; brief mention of alternatives, and/or iterations; some indication of a meaningful design process	Minimal attempt to explain design alternatives or an iterative design process; or the process/project is simplistic, trivial, superficial, irrelevant, poorly explained, or very vague
Quality of justifications	Arguments are logical, clear, complete, substantial, and sophisticated; supporting citations are complete and authoritative	Arguments are logical, clear, and complete with some degree of sophistication; effective use of citations to support almost all arguments	Arguments are logical and clear with no significant gaps; effective use of citations to support some arguments	Credible effort to justify decisions, but arguments are difficult to follow, unpersuasive, or have many gaps; credible effort to use citations to support arguments	Arguments are missing, minimal, incomprehensible, illogical, faulty, simplistic, superficial, trivial, or vague; citations are missing or poorly used

Table 8: Engineering Design Process Rubric

Group Name:
Evaluator Name:

Deliverable	Rubric	Max Score	Score
Demo	Project Demo	100	
Presentation	Oral Presentation Evaluation	100	
Presentation	Real World Business Problem	100	
Report	Problem Analysis	100	
Report	Engineering Design Process	100	
	Total	500	

Table 9: Scoring Sheet