ROBOTIC DESIGN – MS/HS

OVERVIEW

ELIGIBILITY

Open to high school chapters.
Three (3) teams of two to five (2-5) members per chapter may participate.

ATTIRE

TSA competition attire is required.

PREPARATION

A. Participants access the annual theme in the Colorado TSA State Competitive Events Guide.
B. Participants will research the home inspection process. Collect, record, and present data from research. Participants should use this research to inform their design journey.
    a. What is involved in a home inspection when purchasing a home?
    b. What aspects of a home inspection (not just crawl spaces) could be improved, using a robot?
    c. What potential issues could be identified / checked or quantified using electronic sensors?
    d. How could collected data (metrics & visual) be easily recorded / compiled for a home owner report.
    e. How is robotics / technology currently used in home inspections?
C. Participants will design and build a unique remotely operated (or tethered if remote controled is not possible) home inspection Robot that meets the challenge as stated in the annual theme [Design and build a home inspection robot].

REGULATIONS AND REQUIREMENTS

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

PRELIMINARY ROUND

A. <u>The Documentation Portfolio</u>
    a. The documentation portfolio must be saved as a single, multi-page PDF document with the pages presented in the following order:

        i. Title page with the event title, the conference state, the year, and the team ID number; 1 page.
        ii. Table of contents; 1 page.
        iii. Research findings; 2 pages.
        iv. Describe with sketches and annotations, how the robots capabilities were achieved; 2-3 pages.
        v. With the use of sketches, annotations, pictures, etc, demonstrate evidence of the design journey. Include initial concepts, ideation, and final solution. Ensure that each element of the **Design Thinking or Engineering Design** cycle is evident; 5-8 pages.
        vi. Photographs of the build process, showing how each part of the robot was assembled. 1-4 pages.
        vii. Orthographic drawing of robot, ***5 Extra points for the use of a CAD program***; 1-2 pages.
        viii. 5 Extra points for examples of original code written by students.
        ix. References and Resources in proper Modern Language Association (MLA) or APA; 1 page.
        x. 5 Extra points may be awarded for evidence of students applying skills not listed, (examples include but are not limited to; wire schematics, digital graphics, PCB manufacturing, power management, etc.)

B. <u>The Design/Build Process</u>
    a. The physical robot must be designed and constructed prior to the conference.
    b. Robots are to be constructed to achieve the objectives of the design challenge.
    c. Physical robots can be built from recycled, salvaged, or commercially available materials /

kits. Any robotics platform or vendor can be used. Any robot control system can be used. Commercial kits can be used, combined, adapted and /or re-engineered for the Design Challenge. Examples include, but are not limited to; VEX, LEGO, TETRIX, Fisher/Technic, Lynxmotion, Arduino, Raspberry Pi.

d. The robot must initially fit in a space 16" wide x 16" long x 12" tall, but can expand if needed.
e. The robot can be controlled autonomously or by multiple remote control devices (tethered or wireless). Up to two operators may control the robot during the task demonstration.
f. The robot may be controlled via a wireless transmitter or by tether. (Note: tether cables must be long enough to complete the challenge without the operator(s) entering the danger zone.

C. Submission
   a. Participants will submit their entry (robot and portfolio) at their scheduled interview/testing time (a sign up will be posted at the conference).
   a. Submission information will be provided in the Colorado TSA State Competitive Events Guide.
   b. Entries received, or changes made to the submitted entries after the preliminary round, will not be judged.
D. Judges will score the entries.
E. Up to twelve (12) semifinalists will be announced to participate in the interview, semifinals round.

EVALUATION

PRELIMINARY ROUND

A. The documentation portfolio
B. Challenge Course score

SEMIFINAL ROUND

A. The Interview
   a. Participants sign up for an interview time.
   b. At the start of the interview, participants will present a "sales pitch", highlighting their robots capabilities (max 2 min).
   c. Participants respond to interview questions.
   d. Participants may reference their portfolio and robot.
B. Judges score the interviews.
C. The top three (3) finalists are announced.

STEM INTEGRATION

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

LEADERSHIP AND 21ST CENTURY SKILLS DEVELOPMENT

This event provides an 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 or more of the careers below:

- Law Enforcement
- Search and Rescue
- Biomedical engineer
- Civil engineer
- Electronics engineer
- Environmental scientist
- Geophysicist
- Manufacturing consultant
- Mechanical engineer
- Data scientist
- Robotics engineer

DESIGN CHALLENGE: Home inspection Robot (crawl space)

When purchasing a home, home buyers often employ a home inspector to identify issues with a home they are in the process of purchasing. The inspectors' report informs the home buyer of potential issues with the home. The report can greatly impact negotiations and have legal implications for the home seller and buyer.

This challenge will focus on the crawl space portion of a home inspection. The crawl space is often difficult for inspectors to navigate and can be potentially dangerous if there is animal feces, toxic gasses / materials present. A robot will allow the inspector to stay safer, while still gathering information and data from inspecting the crawl space.

Crawl space Robot Challenge

A promident robotics company has hired your team to design and build a prototype crawl space home inspection robot. The robot must be able to complete the following:

- Navigate over dirt, gravel, and if possible, pieces of wood 19mm high and 38mm wide ("1x2").
- Use sensors to identify / check any potential issues (as defined by your research, See PREPARATION, part B).
- Collect evidence of identified / checked issues.

Use the Challenge Course to demonstrate and give a "sales pitch", showing the effectiveness of your robot. Your objective is to "sell" your robot design to the promident robotics company who hired you. The judges will take the role of the decision makers in the promident robotics company. Use the challenge course to demonstrate all the features of your robot. You will be given the opportunity to further promote / "sell" your robot design during the semifinal / interview round.

Note for Middle School teams:
Focus on building a functional and aesthetically pleasing robot that can safely transverse across sand and gravel. If time and resources allow, add features such as a camera transmitter / receiver and / or sensors / functions. It is not expected that middle school teams include sensors, please focus on the design and assembly of a robot that can traverse the rough terrain of a crawl space.

Useful & related resources:

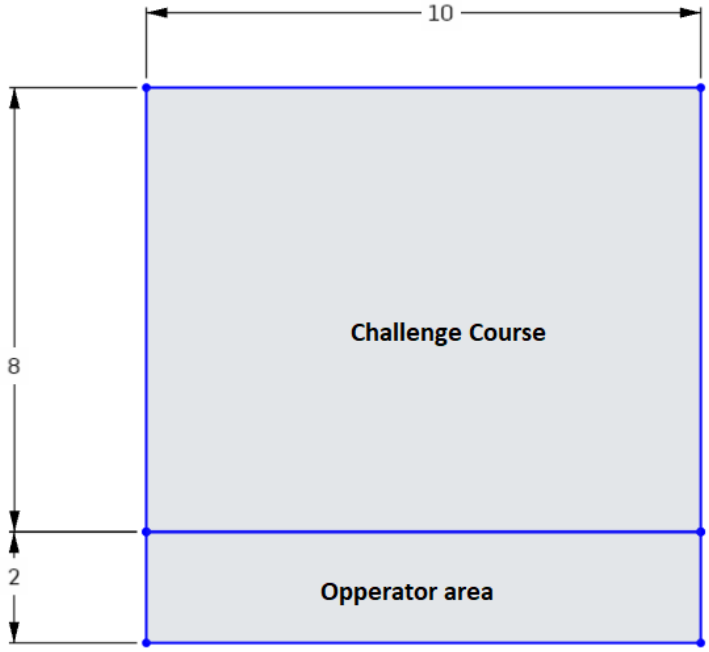
- Engineering design cycle
- Design thinking
- Example robot
- Vex kit
- Raspberry pi robot kit
- Arduino robot kit
- Sensors
- MQ2 sensor and amazon link
- FPV camera and transmitter
- FPV receiver or Android FPV receiver
- Transmitter and receiver
- TX/ RX arduino tutorial
- Consider using an old cell phone or digital camera in lieu of a FPV system, if a FPV system is not obtainable.

ROBOTIC DESIGN CHALLENGE COURSE MATERIALS AND SET UP

The Field:

Rough terrain will be simulated, including sand and gravel. Points of interest will be made clearly visible for your robot to inspect.

- Robot must be no larger than 16” x 16” x 16”, but may unfold to occupy a larger space when in the challenge course.
- Operator area: 2’ x 10’ area.
- Challenge area: 10’ x 8’.
- Note; one 110V, 10 amp electrical outlet and one small table will be provided in the operator area if needed.



Materials :

- A sample area covered in Sand.
- A sample area covered in Gravel.
- A sample of 1” x 2” furring strip to be driven over, if possible.
- A controlled sample of butane for any sensors to detect.
- A controlled sample of water for any sensors.
- Robots equipped with a humidity sensor should be capable of recording / displaying the humidity.
- Robots equipped with a temperature sensor should be capable of recording / displaying the temperature.
- A broken pipe will be visible, robots equipped with a camera should be capable of capturing evidence of this.
- Please inform judges if you have sensors that detect other things not listed above. Ensure that you can safely demonstrate the sensors during the challenge course.

Participant/Team ID#

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ROBOTIC DESIGN

2023 OFFICIAL RATING FORM

MIDDLE AND HIGH SCHOOL

Judges: Using minimal (1-2 points), adequate (2-3points), or exemplary (4-5 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. 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.

Documentation portfolio was submitted

ENTRY NOT EVALUATED

DOCUMENTATION PORTFOLIO (35 points)				
CRITERIA	**Minimal performance**	**Adequate performance**	**Exemplary performance**	Record scores in the column spaces below
	1-2 points	**2-3 points**	**4-5 points**	
Portfolio	Portfolio is unorganized and/or is missing three or more components.	Portfolio is missing one or two components, and/or it is loosely organized, and/or it lacks sufficient content.	All components are included in the portfolio; content and organization are excellent.	
Research	Little to no evidence of research of the home inspection process	Students researched the home inspection process, highlighting the relevance to their project.	Students demonstrate how their research informed their design journey.	
Robot capabilites	Sketches and annotations are used to briefly describe how the robot capabilities are achieved.	Sketches and annotations are used to broadly describe how each robot capability is achieved.	Sketches and annotations are used to accurately describe how each robot capability is achieved in detail.	
Design journey	Each step of the design thinking or engineering design cycle is documented.	Each step of the design thinking or engineering design cycle is documented, showing the clear evolution of the product.	Each step of the design thinking or engineering design cycle is documented, showing the clear evolution of the product. Each step shows critical consideration and problem solving.	
Orthograhic drawings	3 views are completed, in the correct orientation, with main dimensions and features communicated.	3 views are completed, in the correct orientation, with main dimensions, features, and hidden details communicated	Drawings are neat and tidy, relevant details are included (examples could include materials, part numbers, page border, etc).	
Build process	Photographs document the build process, showing how some parts of the robot was assembled.	Photographs and annotations document the build process, showing how most part of the robot was assembled.	Clear and detailed photographs and annotations document the build process, showing how each part of the robot was assembled.	
References and Resources	A list of tools, software (if any) and resources/references used was not included or is incomplete and/or MLA format is not used.	A list of tools, software (if any) and resources/references used is included. MLA format is used.	A detailed list of tools, software (if any) and resources/references used is included. MLA format is used.	
Bonus Points	Up to 5 bonus points may be awarded for the proficient use of a CAD program to create detailed orthographic drawings of the robot.			
Bonus Points	Up to 5 bonus points may be awarded for students writing their own code, enabling their robot to function.			

Bonus Points	Up to 5 bonus points may be awarded for students applying and demonstrating skills not listed, (examples include but are not limited to; wire schematics, digital graphics, PCB manufacturing, power management, etc.)	
	DOCUMENTATION PORTFOLIO SUBTOTAL (35 points)	0

ROBOT CONSTRUCTION (45 points)				Record scores in the column spaces below
CRITERIA	**Minimal performance**	**Adequate performance**	**Exemplary performance**	
	1-3 points	**4-7 points**	**8-9 points**	
Specifications	Robot is over more than one size requirment by less than 2 inches each.	Robot is over one size requirment by less than 2 inches.	Robot meets all size requirements.	
Construction	The robot is poorly constructed; parts are loose/poorly fitted.	The robot is constructed well. Parts are tight fitting.	The robot is neatly constructed with many intricate parts that are well fitted. There is great craftsmanship, evident by tight tolerances, appropriate material selection and processing.	
Aesthetics	Little to no effort has been taken to ensure the robot appears professionally built. Little or no attention to neatness. Examples include but are not limited to; wire management, robot shell, color, finish, style, component layout, etc.	Construction is neat and there is evidence that the aesthetics of the robot was taken into account.	Appearance is of excellent quality and exemplary appearance both on the inside and outside.	
Materials	The robot does not make effective use of materials. There are more than two obvious areas for improvement.	The robot makes good use of the materials, though there is some room for improvement.	The robot makes effective and efficient use of the materials. There is obviously great thought put into material choice.	
Creativity and Artisanship	Few unique and innovative concepts are incorporated in the overall design.	Some unique, innovative, and creative concepts are incorporated in the overall design.	Unique, creative and innovative approaches have met the challenges of and are incorporated in the design.	
			ROBOT CONSTRUCTION SUBTOTAL (45 points)	0

ROBOT PERFORMANCE (20 points)		Record scores in the column spaces below
CRITERIA	**Performance (5points max per criteria)**	
Robot agility	Robot moves successfully transverses forward, backwards, left, and right, over sand and gravel.	
Identification of issues	Robot can use sensors to identify at least 2 potential issues (examples may include but are not limited to; water spill, temperature, humidity, structural integrity of the building, etc).	
Special functions	Team demonstrates a special functions such as; a camera, light, autonomous mode / function, student written code (provide an annotated printout), etc.	
Evidence for report	Robot transmits findings such as but not limited to; data or visual feed to the user. The uer can extract that data / evidence to use in a report for the homeowner.	
	ROBOT PERFORMANCE SUBTOTAL (20 points)	0

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)	0