MESA Mathematics Engineering Science Achievement UTAH

STEM ACTION CENTER U·T·A·H

Arduino Based Solutions for Humans Living in Utah

MESA Utah Engineering Design Competition

Students will implement the Human-Centered Design approach to find a client in your community who has a need, engineer a solution for this need using Arduino as the key component, and present solutions and recommendations for next steps at the MESA Utah Engineering Design Competition. This is the qualifying event for the MESA USA National Engineering Design Competition which will be held in Arizona in June 2019.

April 2019

ARDUINO BASED SOLUTIONS FOR HUMANS

MESA USA & MESA UTAH ENGINEERING DESIGN CHALLENGE

The state competition will be the qualifying event for the national competition.

State Event Registration: https://www.surveymonkey.com/r/arduiosolutions19

All registrations and project reports are due by Friday, April 5, 2019.

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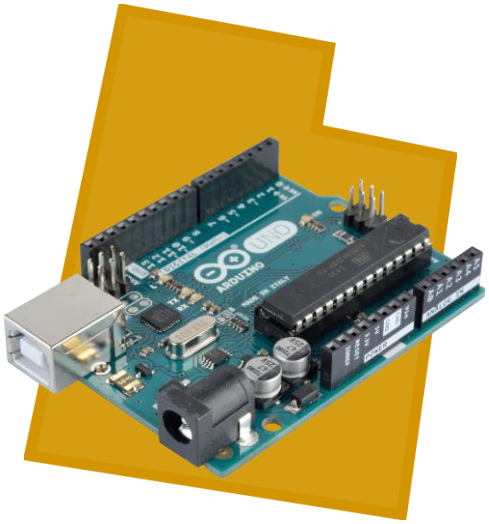
Competition Website: https://mesaut.org/resources/nationalcompetition/

ARDUINO BASED SOLUTIONS SOLUTIONS FOR HUMANS LIVING IN UTAH

Utahns face several conservation and environmental challenges, that pose difficulties to daily life and to the future wellbeing of Utah communities. Among these challenges, are:



(A) Outdoor air quality
(B) Indoor air quality
(C) Drought and limited water supply
(D) Drinking water safety
(E) Light pollution

Identify one specific problem related to one of the conservation or environmental challenges facing Utahns. Do not try to solve the broad problem of everything related to the problem you chose. Focus, instead, on a narrow aspect of the problem. Think about who the specific people are that this specific problem most effects. These will be your clients.

As you begin work on your project, be sure to research the problem and interview one or more clients.

You will design an Arduino-based solution to help your clients. Your device must be cost-efficient and marketable. Your device must either:

(A) help your clients cope with negative effects of the problem, or
(B) help your clients solve an aspect of the problem.

MESA UTAH COMPETITION NOTES AND UPDATES FOR 2018-2019

RULES UPDATE:

MESA USA has changed some of the event rules & rubrics as well as the resource document. Study the rules to find the changes. Be sure to notice the market research section of the Product Pitch event.

DATE AND LOCATION CHANGE:

The MESA Utah Arduino Based Solutions competition will be held at a College, University, or public school this year. The event will be held on a Saturday in April. The exact date an location will be announced later. This change was made for the following reasons:

- Many students were having conflicts with AP testing when the event was held during the school day in May.
- When the competition is held in May, it is a rush for the winning teams to get school board approval to travel out of state.
- The new MESA competition style is more suited to an academic setting that includes a large lecture hall or auditorium.
- MESA Utah will continue to support USU Physics Day at Lagoon by sponsoring the following events:
    - MESA Utah Mousetrap Car
    - MESA Utah Arduino Car Race

      See: https://mesaut.org/physics-day/

THEME:

Students will select a project related to the environmental and conservation concerns of people living in Utah. (See Page 3)

MESA UTAH COMPETITION NOTES AND UPDATES FOR 2018-2019

MESA USA EVENT TRAVEL:

Last year, MESA high school students received National Science Foundation travel scholarships to attend the national competition in Philadelphia. It is likely that this travel scholarship will be available again for the 2019 competition in Arizona. There is a possibility that that scholarships will be offered to middle school students this year. The charter school or school district of the winning team will be responsible for travel expenses. The national competition will be held in late June.

MIDDLE SCHOOL / JUNIOR HIGH SCHOOL:

Middle school teams are encouraged to participate. Utah has not sent a middle school team to nationals for the last two years. We would like to send one this year. Fifth and sixth grade students may participate in the middle school competition.

UTAH COMPETITION RULES FOR 2018-2019

1. Each team must consist of either 3 or 4 MESA students. Each team must consist of at least 50% female and/or ethnic minority students.
2. Follow the rules and guidelines provided in the National Engineering Design Competition Rules and Rubrics Packet.
3. Registrations are due by **April 5, 2019**. https://www.surveymonkey.com/r/arduiosolutions19
4. Project reports are due by **April 5, 2019**. Email project reports in PDF format to: mesautah@graniteschools.org.
5. Late reports will receive a 25 point deduction and no late papers will be accepted after **April 9, 2019**.
6. Teams that do not submit project reports by April 9, might or might not be allowed to compete in the remainder of the competition. This will depend on time constraints and how many other teams are competing.
7. Teams may wear either business casual clothing or matching shirts.
8. Bring your PowerPoint presentation on a USB thumb drive.
9. There is no guarantee that Wi-Fi will be available at the competition venue and teams must plan accordingly.
10. Judges will receive anonymous versions of the technical papers. Students must provide identifying information on the cover sheet. Later, we will redact identifying information such as the school name.
11. Projects that include human subjects, vertebrate animal subjects, or hazardous substances, will need to (A) follow school and district rules and (B) gain SRC/IRB approval: https://slvsef.org/faq#src.
    The purpose of this rule to keep you safe. Ask your advisor for advice if you have questions.
12. Student projects must relate to the environmental and conservation concerns of people living in Utah (see page 3). Student projects must meet the requirements of the NEDC Rules & Rubrics.
13. Any corrections or updates to the rules will be posted on the competition website: https://mesaut.org/resources/nationalcompetition/

ARDUINO BASED SOLUTIONS FOR HUMANS IN UTAH DEVICE CONSIDERATIONS

- Make sure your device collects data via sensors and then physically does something based on the data it receives.
- Your client will not want to use the Arduino Serial Monitor, so make sure that your device can be used independently, without a computer attached.

MESA USA

NATIONAL ENGINEERING DESIGN COMPETITION (NEDC)

2018-2019

MESA Arduino STEM Solutions

Overview

In order to maximize each team's experience during this event, it is important to properly execute all aspects of the judging process and event administration. Although each MESA state may elect to present this event in different format(s), the MESA USA host site and the corresponding National Event Planning Committee will adhere to the processes outlined below. Please note that the following processes not only outline the event but also the roles and responsibilities of student team members and advisors.

MESA USA Code of Sportsmanship

During the course of this event, MESA students, staff, advisors and supporting family members will be expected to act in a professional and courteous manner at all times. All judges' decisions are final. Staff, advisors and parents shall not engage judges during the event.

Contents:

Introduction:

There's an old saying that states "Necessity is the mother of invention." Humans have always been most creative, most inventive when they've had a need and lacked a way of resolving it. This idea is the basis for what we know as the field of Engineering.

As a way to find a solution to a need, engineers implement the **Engineering Design Process**. This process allows Engineers to systematically identify the need and any obstacles or challenges; draft ideas for a solution applying their knowledge of math and science; refine their ideas through testing; and ultimately develop a way to meet the initial need.

Human-Centered Design is an approach in engineering that focuses on people and their specific needs. According to IDEO.org (http://www.designkit.org/human-centered-design), **"Human-centered design is all about building deep empathy with the people you're designing for…"** IDEO further suggests that Human-Centered Design consists of three phases.

1. Inspiration - Engineers learn directly from their client in order to deeply understand their needs.
2. Ideation - Analysis of what's learned from the client leads to design ideas and possible prototypes.
3. Implementation - building of the final proposed solution knowing that it meets the needs of your client.

Competition Overview:

MESA USA presents the National Engineering Design Competition specifications for the 2018-2019 year. **Arduino Based Solutions for Humans** asks students to implement the Human-Centered Design approach to find a client in your community who has a need, engineer a solution for this need using Arduino as the key component, and present your solution and recommendation(s) for next steps at the MESA USA National Engineering Design Competition. All projects should be new and original work. No projects from previous years may be used.

MESA states may choose to keep the event open-ended or may require teams to focus on a particular area of need (i.e. agriculture, physical disabilities) or provide a specific client for teams to focus on at their state competitions.

The components listed below will be used to assess the effective implementation of a Human-Centered Design approach, effective implementation of the Engineering Design Process, the functionality of the prototype, and successful integration of Arduino as the main component of the prototype.

High school and middle school teams selected to participate at the national event will compete in the four components below:

1. **Technical Presentation & Interview**- The objective is to provide an overview of the prototype functionality including a technical explanation of the mechanical operations, software operations, and integration of the two. Students will prepare a short presentation and demonstration of the functionality of the prototype followed by a question and answer session with judges.
2. **Poster & Symposium** - The objective is to provide an overview of their project, highlighting key points of the design process including relevant data, presenting the resulting prototype, and share conclusions and recommendations for further development. Students will prepare a printed academic poster which can be used during a public poster symposium to provide an easily understood overview of the project and the prototype. The poster will also be required during the Technical Presentation & Interview.

3. **Project Report** - The objective is to provide an overview of the design process and demonstrate team's effective use of the Engineering Design Process. Students will write a 5-10 page report that contains their problem statement, summary of the design process, results, conclusion and next steps supported by pictures, charts, tables, and/or graphs. The report should be a journey through the design process and demonstrate key points of the process and why design choices were made. The report will have an appendix containing the commented Arduino code and detailed budget.
4. **Prototype Pitch -** The objective is to convince investors or management that the design meets the client's needs, is superior to other options available, and has business value as a product. Students will prepare a creative, engaging presentation to pitch their prototype to an audience, including a group of judges. The presentation should define the problem; provide a detailed description of their client and their needs; discuss current solutions to the problem and their weaknesses; provide a demonstration of their prototype highlighting its advantages, and demonstrate the business value of the product including a market analysis and marketing plan.

Each competing team must consist of 3- 4 students who are active members of a MESA program in a MESA USA state. Individual states should encourage their respective teams to participate in all performance components at the statewide level. Although states may opt not to do all components or alter some requirements for their local and state events as needed. Individual states will determine the dates and location of their respective events.

The first place middle and high school teams from State events will travel to the national competition. These teams must compete in all tasks listed above. This event is scheduled to occur in **June 2019** hosted by Arizona MESA.

Plagiarism Policy

Academic honesty and personal integrity are essential to ensure future success as college students and STEM Professionals. As such, MESA USA expects that the work presented as a part of the National Engineering Design Competition will be solely the work of the students. If the work or ideas of another are used to further students' work then proper credit must be given to the owner (see resource document for information on citing sources). Failure to do so will result in an act of Plagiarism. If it is determined that a student committed plagiarism, they will be disqualified from the competition and they will be ineligible to receive any awards. They may also risk further sanctions from MESA USA and/or their MESA state organization.

Scoring Summary

Final team rankings will be based on the total score, which is derived by adding all of the component scores

Technical Presentation & Interview	100 points
Poster Symposium	50 points
Project Report	100 points
Prototype Pitch	100 points
Total	**350 points**

Technical Presentation and Interview:

Overall Objective

The Technical Presentation and Interview allow judges the opportunity to determine student knowledge of their project, gain information about the design process the students used during the project, and determine viability of the design for the client. A technical presentation has a different focus than a pitch, and therefore, this presentation should be different from the Project Pitch component of the National Engineering Design Competition.

Students will organize and deliver a focused, coherent presentation to provide an overview of the development of their design (including research, experimentation, iterations, and conclusions), the technical components of their design, and demonstrate the functionality of the prototype. The presentation should provide an overview and demonstration of the prototype functionality as well as include an explanation of the mechanical operations, software operations, and the integration of hardware and software. After students present, judges will follow up with a Technical Interview. Students should use their poster, prototype, and other relevant materials as support during the Technical Presentation and Interview session. Displays and speeches must be the original work of the students.

The technical presentation is a summary of technical aspects of the project and the interview is a discussion with the judge panel. Together, they should include:

1. Project Objective
   a. Who is the client and what are the client's needs?
   b. How does this project fulfill the client's needs?
2. Description of Design
   a. How does the design function mechanically?
   b. How is Arduino integrated into the design?
   c. How does the software function?
3. Engineering Design Process
   a. What was your team's methodology and process?
   b. What research did your team do for the project?
   c. What were other solutions that your team thought of to fill the needs of your client?
   d. What were any major challenges and any correlating solutions?
   e. What were the major design choices?
   f. How did the iterations of the design evolve during the project?
4. Conclusion and Recommendations for their project
   a. What tests were completed on your prototype?
   b. What is your final assessment/evaluation of your prototype?
   c. What are the next steps for the implementation of your project?
   d. Are there any suggestions for improvement and/or redesign?
5. Prototype Demonstration:
   a. Teams should be able to adequately discuss their prototype design, chosen materials, chosen hardware, and rationale behind choices, as well as the flow of data from input to output.
   b. Teams should be able to discuss any testing they did during development and how that testing informed their design choices. Teams should be able to discuss how the features that are unique to their design were developed through this process.
   c. Teams should demonstrate the usability of the prototype and how it meets the needs of the client. Teams should have a working prototype. If not, some areas will not be able to be scored.

Technical Presentation and Interview Rules

1. Teams will be randomly selected to determine order. Students must conduct presentations and interviews in the order drawn. No exceptions or late arrivals are allowed.\
2. The Technical Presentation and Interview session will last a maximum of 20 minutes. Teams will have up to 10 minutes to deliver a technical presentation and demonstrate the prototype (presentation time). The remaining time will be used for a technical interview (interview time) with the judge panel.
   a. Judges will notify teams when they have 1 minute remaining in the presentation time (at 9 minutes). At 10 minutes the presentation will be stopped. Teams are allowed to incorporate time for judges to interact with their prototype, but the interaction must be concluded within the time allotted for the presentation.
   b. If the team is finished with their presentation before 10 minutes, the team will give an indication to judges that they are ready for the interview portion of the session to begin.
   c. Judges will announce when there is 3 minutes, and 1 minute remaining in TOTAL time (at 17 minutes and 19 minutes).
3. Teams are to use support material during the technical presentation and interview.
   a. Teams must refer to their poster for support during the presentation.
   b. Teams are encouraged to use other materials such as their engineering notebook, Arduino code, or other visual aids as needed to supplement their technical presentation and interview.
   c. Teams are not allowed to use electronic presentations during their technical interview.
4. Judges will be given a set of prompting questions to use during the technical interview. Questions will typically focus on gaining clarification about the team's project, gathering specific details about information the team presents, or will be in alignment with the major content areas of: Usability, Team Objective, Engineering Design Process, Materials and Technology, Data, Conclusions and Recommendations, and Support Materials.

Materials Provided

- Easel or ample wall space for poster.
- Table for display and/or demonstration.
- Electricity will be available for the Technical Presentation and Interview.
- Wireless Internet may be available, but is not guaranteed.

Poster & Symposium:

Overall Objective: Provide an overview of the project, highlighting key points of the design process including relevant data, presenting the resulting prototype, and share conclusions and recommendations for further development. Students will prepare a printed academic poster which will be used during the Technical Presentation & Interview and during a public poster symposium to provide an easily understood overview of the project and the prototype.

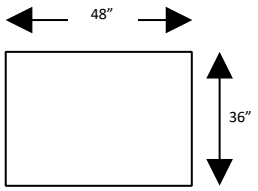
The Poster is an important support element that as a standalone should help the observer understand the overall scope, resulting prototype, and next steps of the project. As a visual aid the poster can be a powerful providing important graphics and highlights of key features to emphasize points made verbally during any presentation.

Poster Symposium

- Students will be expected to participate in a poster symposium at the National Event. Students will display their posters and prototypes and be available to present their designs and answer any questions to those attending the symposium. This event will be open to all event attendees and will provide an opportunity for student teams to interact with one another and learn more about each other's projects.

Poster Requirements

1. Size and Type. Teams must design and print a single poster for the National Event. The maximum size of the poster is 36" by 48". The minimum size is 24" by 36".
   **State and local events may opt to allow tri-fold presentation boards with maximum dimensions of 36" x 48". Tri-folds brought to the National Event will receive zero points for their poster.



Poster example only

2. Posters should include a title at the top of their poster.
3. A team section must be present and should include:
   a. School Name
   b. Grade level representing (Middle School or High School)
   c. State representing (Optional at State and Local Events)
   d. Team members' names.
4. An Official MESA logo should be included (contact your state office for a logo).
5. Posters should include the following elements:
   a. Problem Statement: This defines the problem to be addressed. This section could include:
      i. Description of variables and how they are addressed.
      ii. Description of problem(s) addressed by prototype
      iii. Scope of the project and any priorities in design
   b. Objective: This defines how the problem is being addressed. This section could include:
      i. Specific variables addressed.
      ii. Desired attributes of the design
      iii. Design choices to fulfill client's needs
   c. Prototype: A picture/schematic of the prototype. This section could include:
      i. Short descriptions of important pieces of prototype
      ii. Highlights of device
      iii. Unique elements of prototype
   d. Code: How the Arduino is coded. This section could include:
      i. Commented code
      ii. Psuedocode flowchart
   e. Trade table: A comparison between the prototype and current products on market. This section could include:
      i. Cost
      ii. Features
      iii. Specifications
   f. Data: The relevant data that helped drive the prototype. This section could include:
      i. Line graphs
      ii. Circle graphs
      iii. Bar graphs
   g. Results/Conclusions: The end result of the prototype. This section could include:
      i. Summary of results
      ii. Next steps

   iii. Future of prototype
h. Engineering Design Process: The team's methodology. This section could include:
   i. A flowchart of your processes.
   ii. A graphic of your processes.
   iii. An arrow diagram of your processes.
i. Title & Tagline: Identifiers for your project. This section could include:
   i. A take away for people who read the poster.
   ii. An identifier for the project

6. The team's Engineering Design Notebook should be available during your presentation so your team, or judges, can refer to it.
7. Electronic media are not allowed.

Materials Provided

- Easel or ample wall space for poster – or cafeteria-style table (approximately 30" x 72" x 29"). If a table is provided, teams will need to provide their own poster stand.

Project Report

Objective: Demonstrate the successful development of a prototype through implementation of the Engineering Design Process. This report should be a summary of your project that leads judges through each stage of the Design Process. You should provide an assessment of the problem you are addressing; identify your client(s) and provide an evaluation of the needs that informed your design choices; present your decision making processes including testing and data analysis; and present the progress or results of your work.

Required Elements:

The report should include the following sections

1. Title Page - must include authors/team members, school, MESA state, and date of publication.
2. Problem Statement –a detailed assessment of the client(s) and their needs, an evaluation of the specific need(s) addressed by the proposed solution, and any limitations that influenced the project.
3. Design Process
   a. Key design choices based on prior knowledge, research, and client's needs.
   b. Prototype development showing an iterative process with clear linkages between client's needs, testing conducted, and data analysis. This should include a discussion of the math and science concepts used in design development, testing, and data analysis.
   c. Discussion on the use of and integration of Arduino.
4. Results - final iteration of the prototype highlighting strengths
5. Recommendations for further development or next steps for production
6. Appendix
   a. Data (Charts, Graphs, Tables)
   b. Commented Arduino Code (see examples in the resource document)
   c. Detailed Budget Sheet (see examples in the resource document)
7. Bibliography

Length:

The report should be no less than five pages and no more than ten pages in length not including the Title Page, Appendices or Bibliography. Thorough but concise reports are encouraged.

Conventions (Format, Language, Grammar, etc.)

Each of the standards listed below, though they are scored at a lower level, make an enormous difference in your team's ability to create a well-organized, compelling report. Do not forget to check your report length, make sure all sections are included, and adhere to the font, spacing, layout, and grammar standards below:

a. The report length should be 5 to 10 pages not including the title page, appendices or bibliography
b. Remember to include the key sections in your report (listed above)
c. Your title page must include authors/team members, school, MESA state, and date of publication.
d. Be sure to use 1" margins and double-space your text using 12 pt. Times New Roman font.
e. Remember to use spelling, sentence, paragraphing and transition conventions that are appropriate to standard business English throughout the paper.

Written Presentation

The report should be typed, double-spaced, and have a cover sheet. When possible, graphics should be computer-generated. The above conventions should be followed. Readability will help your report achieve a higher score during judging.

Deadline:

- *Local/State. Check* with your local MESA office for the procedure for local/state competitions.
- *National Competition. For teams advancing to the national competition,* the project report must be submitted via e-mail to Arizona MESA on or before 4:00 pm in your local time zone, on **June 7, 2019** (subject to change)**.** Papers should be submitted by a student team member. The papers will be judged and scored prior to the National Competition. Late papers will be assessed a 25 point deduction from their report score, and no reports will be accepted after **June 10, 2019.**
- Technical reports **MUST** be submitted in Portable Document Format (.PDF). Teams shall ensure the submitted final product can be read using Adobe Reader (10.0 or newer) and that it matches your original, printed document. The maximum file size for submission will be 9MB. A PDF version of the final report must be e-mailed to: Arizona MESA, Head Judge at azmesa@email.arizona.edu. Check the MESA USA national website at mesausa.org for further information.
- ***Please note that the host and Head Judge are not responsible for any Internet service delays or misdirected reports. It is the responsibility of the student team members to ensure that the report is delivered successfully in the proper format prior to the deadline. Therefore, submission of materials in advance of the above-listed deadline is highly recommended.***

Prototype Pitch:

Objective:
The objective is to convince investors or management that the design meets the client's needs, is superior to other options available, and has business value as a product. Students will prepare a creative, engaging presentation to pitch their prototype to an audience, including a group of judges. The presentation should define the problem; provide a detailed description of their client and their needs; discuss current solutions to the problem and their weaknesses; provide a demonstration of their prototype highlighting its advantages, and demonstrate the business value of the product including a market analysis and marketing plan. The pitch should differ from the Technical Presentation and be a complete presentation as questions will not be allowed.

Pitch Rules

1. Teams will have 10 minutes to present. A 5 point deduction will be assessed for each minute over the allotted time. Judges will provide time signals to presenters at 1 minute before the 10-minute limit and every minute thereafter. After +2 minutes (a total of 12 minutes), judges will stop the presentation.
2. The pitch will be open to the public. States may opt for private sessions at state and local events.
3. Teams will present a prototype pitch to the audience, which will include a group of judges.
4. Teams are allowed to bring additional audio and visual aids to enhance their presentation.
5. The pitch must include and will be assessed on the following:
    a. Client Introduction and Problem Definition
        i. Describes the client base
        ii. Describes the problem they are solving and its impact on the client
        iii. Describes how design requirements keep target users in mind
        iv. Discusses the current market solutions
    b. Product
        i. Defines the proposed solution through the prototype
        ii. Explains the originality and innovativeness of their design.
        iii. Presents the advantages of the presented prototype
    c. Demonstration of the prototype
        i. Explains key features and functions
        ii. Explains how design meets client's criteria for look, feel, and functionality
        iii. Provides evidence that design is easy to use by clients
        iv. Describes the potential of the design as a product and/or in the current market
    d. Business Value
        i. Provides a market analysis
        ii. Considers the price point and strategy
        iii. Includes a marketing plan
6. Teams will also be assessed on the quality of the presentation, including:
    e. The effectiveness of their communication (speaking volume and pace, body language, eye contact)
    f. The organization of their presentation
    g. The depth and understanding of the content
    h. Quality and creativity of the presentation including any visual aids
    i. Introduction and participation of all team members in the presentation
7. Teams will be randomly selected to determine the order of presentations. Teams must give their pitches in the order drawn. No exceptions or late arrivals.

Materials Provided:

- A projector and laptop with PowerPoint and internet access.
- Wireless Presentation Remote
- Access to electricity for prototypes
- Cafeteria-Style Table (approximately 30" x 72" x 29")
- Special Requests for other materials will be considered but are not guaranteed.

School:_____ MS HS State/Center:_____

Technical Presentation and Interview Rubric:	LEVEL OF MASTERY						
	Exceptional (5 points):	Excellent (4 points)	Met Criteria (3 points)	Fair (2 points)	Poor (1 point)	Not Present (0 points)	Notes
Design Overview: The client is well defined and the design meets all of the requirements and the needs of client.							
Design Knowledge: Team demonstrates adequate knowledge of project. All design elements are intentional and thought out.							
Usability: The team can adequately articulate prototype instructions and purpose. Judges can understand how the prototype is used by the client.							
Prototype Demonstration: During the presentation time, the prototype is working and can be demonstrated effectively and with ease.							
Project Impact: The presentation, without additional clarifying questions, increases judges' understanding of the importance of project and future impact.							
Materials: All materials are appropriate for design and for use by the client. Team is logical in material usage and budget consideration. Team can articulate and is knowledgeable about the rationale and purpose for materials used.							
Mechanical Design: The team can articulate and is knowledgeable about details, reasoning, and purpose for the mechanical components of the design.							
Technology Usage: Sensors, Wiring, Breadboard, Etc. Technology is appropriate for the design. The team can articulate and is knowledgeable about all technology used. The use of Arduino hardware and sensors is innovative, effective, and relevant to project. Rationale for selection of hardware components used is conveyed adequately.							
Arduino Usage: Programming Logic Flow The team's Arduino code is logical and team can explain, with adequate detail, their coding choices, modifications, and programming logic.							
Data Collection: Input The selected Arduino hardware and/or sensors efficiently and effectively collect input data. The prototype is able to process input data appropriately. The team can convey what data the device collects and/or what variables are used to result in an output. This includes knowledge of input code and hardware.							
Data Response: Output The selected Arduino hardware and/or sensors respond to data efficiently and effectively. Output is appropriate. The team can convey the output process and what happens during use of the prototype. This includes knowledge of output code and hardware.							

Technical Presentation and Interview Rubric:	LEVEL OF MASTERY						
	Exceptional (5 points):	Excellent (4 points)	Met Criteria (3 points)	Fair (2 points)	Poor (1 point)	Not Present (0 points)	Notes
Engineering Design Process: The team conveys their methodology and process, including the research, planning, creation, testing, and improvement phases, adequately well.							
Challenges and Solutions: The team conveys their project challenges and correlating solutions through presentation or interview. The team is able to incorporate how their research informed their solutions adequately well.							
Testing: Design Choices/Iterations Multiple tests were conducted, documented, and used to improve the design. The team is able to convey testing conditions, variables, and results of most tests. All testing was appropriate for their project. The team can convey how the tests helped to inform their design choice(s).							
Conclusions and Recommendations The team is able to effectively present their final product and discuss conclusive findings, limitations, next steps, and recommendations for further development through presentation or interview. The team is able to incorporate how their tests resulted in their conclusions and discuss the future impact of their project.							
Presentation Skills: The team displays relaxed, self-confident nature and is mostly free of fidgeting and/or nervous movement. Body language was appropriate and did not detract from presentation. The team uses direct eye contact and holds the audience's attention.							
Verbal Skills: The team shows enthusiasm and can verbally convey knowledge about the topic during the presentation and interview session. Team members speak in clear voices and use technical terms correctly. The team shares equally in the presentation and interview time and all show adequate skill and knowledge.							
Support Material: The team is able to effectively use support materials (e.g., poster, logic diagrams, engineering notebook, etc.) to increase the audience's understanding of the project.							
Response to Questions: The team's responses to technical questions demonstrate adequate technical knowledge of the concepts and processes used in the project.							
Team Contribution: All members contribute to the presentation and to answering questions. Team has shown that all members have contributed to the overall project.							
Column Totals:							
GRAND TOTAL:							

Judge Name: _____

2018-2019 MESA USA
National Engineering Design Competition
MESA Arduino STEM Solutions

School:_____ **MS HS** **State/Center:**_____

Poster Rubric	LEVEL OF MASTERY						
	Exceptional (5 points):	Excellent (4 points)	Met Criteria (3 points)	Fair (2 points)	Poor (1 point)	Not Present (0 points)	Notes
Problem Statement: The team adequately defines the problem being addressed by the team in 50 or fewer words							
Objective: An adequate describes how their project address the problem and may include information about the variables addressed, desired attributes, and/or design choices made in 50 words or less							
Prototype: A visual graphic of the prototype is present and highlights innovations and/or important components of the design							
Code/PsuedoCode: Includes an adequate description or example of the processes that run the Arduino and the prototype that can be understood by most observers.							
Trade Table: Provides an adequate comparison between the prototype and current products on the market. Includes at least two points of comparison							
Data: Provides a graph or table that presents relevant information from the results of testing to increase the observers understanding of the project.							
Results/Conclusions: Includes an adequate summary of design process including final results and discussion about the next steps of the project to improve design or bring it to market							
Engineering Design Process: A graphic adequately illustrates the iterative process the team went through to accomplish their objective.							
Readability: The poster is easy to read and has a balanced amount of graphics vs. text			Graphics: About half Text: Concise	Graphics: Some Text: About half	Graphics: A few Text: More than half.	Mostly text	
Title/Tagline: Includes a title and takeaway line for the poster.			Creative & Memorable	Sufficiently Explanatory	Simple Summarization	None	
Size: No more than 36” x 48” and no less 24” x 36”					Yes	No	
School Name included					Yes	No	
Team Member's Names included					Yes	No	
Official MESA logo included					Yes	No	
Column Totals:							
Grand Total:							

Judge Name: _____

2018-2019 MESA USA
National Engineering Design Competition
MESA Arduino STEM Solutions

School:_____ MS HS State/Center:_____

Project Report Rubric	LEVEL OF MASTERY						
	Exceptional (5 points):	Excellent (4 points)	Met Criteria (3 points)	Fair (2 points)	Poor (1 point)	Not Present (0 points)	Notes
Problem Statement The problem is adequately articulated with organized criteria and constraints. The needs of the client have been sufficiently examined to design a solution.							
Design Process - Inspiration: Research Prior knowledge, research, and client(s) interviews are adequately articulated and a specific list of needs has been selected.							
Design Process–Inspiration: Client's Needs The client's needs are adequately accounted for as initial design choices are analyzed.							
Design Process – Inspiration: Client's Needs Client's needs to be addressed are adequately organized and present requirements or limitations							
Design Process – Inspiration: Evaluation(x2) The design process is sufficiently iterative and design changes are examined using previously selected criteria and constraints							
Design Process – Ideation: Arduino Integration (x2) Integration is appropriately adapted, somewhat innovative, and adequately executed to address criteria and constraints							
Design Process – Ideation: Design (x2) Development of prototype is sufficiently connected to knowledge gained and reasoning for design choices is appropriately illustrated.							
Design Process – Ideation: Math and Science (x2) Applied math and science concepts are sufficiently suited for design development and analysis of data to inform design choices							

Project Report Rubric	LEVEL OF MASTERY						
	Exceptional (5 points):	Excellent (4 points)	Met Criteria (3 points)	Fair (2 points)	Poor (1 point)	Not Present (0 points)	Notes
Design Process – Implementation: Testing(x2). Various testing methods were chosen to analyze if design effectively meets established criteria and constraints.							
Design Process – Implementation: Data Data analyzed is mostly clear, sufficiently concise, and relevant to project. Data illustrates claims made.							
Design Process – Implementation: Data Charts and graphs are suitably chosen, labeled and fairly easy to interpret.							
Design Process – Implementation: Data Analysis (x2) Data analysis is used to examine strengths, weaknesses, effectiveness. Results of testing are used to implement design changes.							
Spelling & Grammar				No errors	Minor errors	Many errors	
Code				Easy to read Clear comments	Difficult to read.	Minimal/ non-existent.	
Budget				Complete	Mostly Complete	Inadequate	
Bibliography				Complete research & data. Consistent format.	Most research & data Consistent format.	Inadequate research & data	
Length				5-10 pages	4-11 page	<4 or >11	
Column Totals							
Total							

Judge Name: _____

School:_____ **MS HS** **State/Center:**_____

Pitch Presentation Rubric	**LEVEL OF MASTERY**						
	Exceptional (5 points):	Excellent (4 points)	Met Criteria (3 points)	Fair (2 points)	Poor (1 point)	Not Present (0 points)	**Notes**
Client Intro and Problem Definition (Total 20 Points)							
Client description - Client base is identified and a adequate profile, including information on population size and location is provided so that observers have few questions about the client base.							
Problem Description and Impact - A clear and suitable description of the problem and its impact to the client is provided and some crucial aspects that need to be addressed have been explained.							
Human Centered Design - While keeping the target user(s) in mind – teams adequately explain the design requirements needed for the solution to succeed.							
Current Market Solutions – Some current solutions are listed and teams sufficiently articulate improvements over existing products.							
Product (Total: 15 points)							
Define Proposed Solution - Team adequately defines their proposed solution through their prototype and is able to sufficiently articulate how their research, design, and testing led to the prototype.							
Originality and Creative Ability - Team adequately explains how their design and approach to solving the problem is mostly original and/or somewhat innovative and are able to sufficiently explain how their research helped to design a solution in a creative way.							
Advantages of solutions - Team suitably describes advantages of prototype over other solutions for client - citing a few reasons for being the best solution for client.							
Prototype Demo (Total: 20 points)							
Demonstration – Sufficiently explains key features and functions of the prototype.							
Product look, feel and functionality - Teams adequately explain how their design met the client(s) criteria for functionality, elegance, aesthetics and cost effectiveness. The product is suitably safe to build, use, store and dispose of.							
Ease of use – Team provided adequate evidence that the client was able to use it with no assistance from team. It was functional, mostly smooth, with few pauses or bugs.							
Potential of design -Team sufficiently describes the next steps they need to undertake to bring prototype to the client and/or the market –Explaining their forward thinking of product scalability and design improvements.							

Pitch Presentation Rubric	LEVEL OF MASTERY						
	Exceptional (5 points):	Excellent (4 points)	Met Criteria (3 points)	Fair (2 points)	Poor (1 point)	Not Present (0 points)	**Notes**
Business Value (Total: 15 points)							
Market Analysis - Provides assessment of the potential market for their product. Considering market size, buying patterns, competition and possible barriers.							
Price Point Considerations - Teams identify a retail price for their product and explain their pricing strategy.							
Marketing Plan - Teams are able to share a suitable plan for their marketing and advertising efforts.							
Presentation (Total: 30 points)							
Speech organization - Presents ideas and information effectively and includes an Intro, Body and Conclusion. Introduction is suitable and inviting, body is mostly focused and suitably arranged, closing is adequate in unifying entire presentation							
Delivery - Shows an appropriate degree of understanding of ideas, concepts, themes and information. Overall presentation shows sufficient evidence of creativity, enthusiasm, value and believability.							
Visual Aids/Creativity - Adequately demonstrated the use of relevant and appropriate equipment, materials, and props to provide a solid, convincing and interesting presentation.							
Audience Interaction - Team can adequately hold the audience's attention throughout most of the presentation. Audience is sufficiently interested, engaged, entertained and impressed with the teams approach to the problem.							
Communication - Presentation flows well with minimal distracting pauses, speakers are mostly clear and loud and not going too quickly or too slowly.							
Eye Contact & Body Language- Most team members used natural movements and gestures, looks poised and confident. Keeps eye contact with audience most of the time & rarely uses notes or slides.							
Intro of team members Adequately introduced all team members				Yes, Creatively	Yes	No	
Participation All team members should speak and present equally.				All team members participated and spoke equally	All team members participated and spoke but not equally	Not all team members presented and spoke	
Time 5 point deduction for every minute over the allotted 10 minutes.							
Column Totals							
Total							

Judge Name: _____

MESA USA
NATIONAL ENGINEERING DESIGN COMPETITION
2018-2019
Arduino Based Solutions for Humans

RESOURCE DOCUMENT

This document provides critical information to assist teams in successfully meeting all competition requirements, including detailed descriptions and examples of various required elements.

TECHNICAL PRESENTATION & INTERVIEW

As the title states this is a technical presentation and interview, which means, that judges will be looking to understand the most technical aspects of your project with a focus on the final design. Any information presented should be connected to elements of this final design and help the judges understand how this prototype evolved out of the design process, including how research, design, and testing led to specific design elements. Specific information about how the client's needs are met, and the integration of Arduino are also very important.

The technical interview is made-up of two elements: the presentation with demonstration, and the interview. While each will be scored separately, both should work in conjunction to provide an overview of the technical functionality of the presented device.

TECHNICAL PRESENTATION WITH DEMONSTRATION–

The presentation and demonstration is the first part of this component. Teams are expected to provide a verbal overview of their project focusing on the development of the final prototype in a 10 minute presentation & prototype demonstration. The poster must be used to support the presentation, but other visual aids like the engineering design notebook may also be used. During the demonstration, teams can show judges the individual elements of the prototype. The focus should be on the team's success in engineering the prototype. Functionality, hardware and software integration, specific features or elements that set the design apart from others should be highlighted.

Overall, keep in mind the following guidelines for the presentation:

- All team members should share equally in your presentation. No matter what approach you take, please make sure your team's demeanor and presence is well suited for the event.
- All team members' voices should be heard and understood by all judges. All team members' eye contact should be distributed across the audience.
- All team members should stay focused on the topic, transitioning very smoothly from point to point. Do your best to maintain the attention of the judges through discussion.

TECHNICAL INTERVIEW – Q&A WITH JUDGES –

The Q&A with judges is the second component and allows the judges to dig deeper into the team's thought process and design choices. Although judges will be provided with a set of prompting questions, the point of the Q&A is to provide time for the team and judges to have an open discussion about the prototype. Judges will be able to ask about elements that they were curious about that may have been missed in the presentation. Judges may ask for more specific detail about why one material was chosen over another, or why coding processes were done a certain way versus another. All questions will be in alignment with the major content areas of: Usability, Team Objective, Engineering Design Process, Materials and Technology, Data, Conclusions and Recommendations, and Support Materials.

POSTER & SYMPOSIUM

The Poster is meant to be a visual overview of your final design. At the National Event posters will put on display in a public symposium in addition to being used during the interview. The poster should be able to stand alone to provide the viewer; a clear understanding of the project; key steps in the design process that led to this design; and the functionality of the prototype including Arduino hardware and software. Teams will be expected to stand with the poster at all times during the symposium to talk about their design and answer questions.

All posters must be printed for the National Event. Posters can be designed using PowerPoint and templates are available. For additional resources on Academic Poster Design investigate resources provided on the MESA USA site and visit http://gradschool.unc.edu/academics/resources/postertips.html#design.

All posters must have a title, team information, and the official MESA logo (contact your state office for a logo).

POSTER Elements (detailed description by Section)

1. ***Problem Statement:*** This section is a brief overview of the problem that your project addresses. It should discuss the client, the impact on the client, and any specific challenges that your prototype addresses. A good problem statement will not have more than 50 words.
2. ***Objective:*** This section should include a brief discussion of user requirements, highlight design choices made to meet client needs, and overview desired attributes and qualities. A person reading the objective should be able to understand scope of the project and priorities in design in the 30 seconds it takes to read it. A good objective will not have more than 50 words.
3. ***Prototype:*** A picture or schematic of the prototype should be a central piece of the poster and help the viewer understand how your design functions and highlight key attributes and/or innovative features.
4. ***Code:*** A representation of the code used. It can be a schematic, block-logic diagram, or function block diagram. It should help someone not familiar with coding understand the logical process your design goes through to function.
5. ***Trade Table:*** This table should provide a comparison between your design and other designs on the market. It should show how your design is better than others based on things like cost and available features.
6. ***Data:*** Tables and/or graphs that help the viewer understand how your design evolved.
7. ***Results/Conclusions:*** This should provide a summary of the entire project, how your device meets the objective, and next steps for development or marketing.
8. ***Engineering Design Process:*** Provide viewers with the overview of the methodology your team used. A good graphic that outlines the iterative nature of the process and highlights key steps should help you score well in this section.
9. ***Title & Tagline:*** Your title should both give readers an idea what your project is about and make them want to know more. A tagline is a short message that leaves the reader with one big takeaway about your project that you want them to remember.

Overall, teams are also encouraged and expected to:

- Acknowledge references.
- Use color for emphasis and interest but do not overwhelm your reader.
- Consider their use of space to ensure that it will capture and hold the interest of audience members effectively.
- Make sure your design is neat, uncluttered and very easy to follow from the beginning of your project to the end.

PROJECT REPORT

Using Your Engineering Design Notebook as a Foundation for Your Report

Everything you do to prepare for this competition – be it your design brainstorming, your sketching of possible approaches, your informal and formal research, your building of various prototypes, your testing of each material, modification, or new model, or even your gathering and analysis of the data – everything you do to prepare your final design prototype is part of your engineering design process.

Like most STEM professionals, you will be keeping a notebook to make notes of everything you explore. From Day 1 – you will be using your notebook to tracks your ideas, your progress, your letdowns, your innovations, your interviews, your drawings and your data. Each time you meet, open up your team's notebook(s) and document everything – even your goofiest ideas and your worst drawings or testing results – then when it comes time to write your report, you should have most everything you need in that notebook to write a strong project report.

Refer to the Project Report Rubric to further guide you to ensure you are covering all scoring aspects within your report. Make sure to have others review your report using the rubric to provide feedback. The report you submit should not be your first draft.

Contents (Detailed description of each key section is as follows):

A. Title Page

Title, Authors, MESA State, School name and Date need to be included.

B. Problem Statement

This section is an engaging, synopsis of your problem. It should be written using minimal technical terms. It should describe, in detail, the client and their need(s), what need(s) your project is addressing and why, and any limitations you found as you worked through the Engineering Design Process.

C. Design Process

This is the longest section of the report. This section should guide the reader through your entire project showing a clear connection between each stage (Inspiration to Ideation to Implementation). It presents and thoroughly discusses all key evidence from your engineering design process and findings. As you explain these findings, make sure to include the right kind of compelling graphics to help readers better visualize your data or information (e.g. data tables/graphs or other figures/charts) that is embedded in the report. As you explain your process and points, make sure to refer to the appropriate graphic within the paragraph in which it first becomes relevant.

1. Discuss your team's design process, including:
   a. *Process Overview*. Clearly overview your team's design process.
   b. *Research.* Make certain to discuss; prior knowledge about the problem brought by team members; interviews with clients discussing the issue and their needs; and other research done to understand the client's needs, explore current solutions, and information gathered to assist in design process.

c. *Design Process/Testing.* Clearly explain what aspects of your design process (including brainstorming, research, design selections, modifications, testing, etc.) most informed all of your major design choices. Be specific. What part of your process most impacted your choices and how? How did you ensure that the client's needs were accounted for during the process?

d. *Prototype Development* – discuss the evolution of your design including how the client's needs connected to the testing, data analysis, and changes between iterations of the design.

e. *Discussion of electronics hardware integration.* Detail the integration of the electronic hardware components into your solution. Discussion should include breakthroughs, challenges and compromises made to integrate these components.

f. *Discussion of Software development.* Clearly describe the development of the code used to control the electronic components. A copy of your commented code should be included in the appendix (See samples on page 18).

g. *Conclusion and Recommendations.* Clearly define conclusion and recommendations that demonstrate a thorough reflection on the process and final design and include specific suggestions for further development.

2. Quality and Thoroughness

a. *Go The Extra Mile.* Clearly describe any extra measures your team made to be more conscientious in ensuring that your design's quality went beyond the call of the specifications. For example, is your final design durable, or easy for the client to use? If you did a viability or impact study to see the positive and adverse impacts of your design (i.e. on society, the environment, hypothetical clients, etc.), what did you learn?

b. *Testing Procedures.* Clearly describe your experimental procedures and test setup, including relevant pictures or diagrams.

c. *Math and Science Concepts.* Clearly articulate what Math and Science concepts were used throughout the process.

Overall, the discussion section should be imaginative enough to hold the reader's interest and organized logically. Three common ways to organize are shown below:

- *Chronological development:* present information in order of occurrence, which is usually the easiest way to organize.
- *Subject development:* present information by subjects, grouped in a predetermined order.
- *Concept development:* arrange information as a series of ideas that reveal the reasoning process used to reach your conclusions. This requires more careful organization but also allows for more creativity and persuasion. Writers should anticipate reader reactions. If presenting a controversial concept, establish a strong case before discussing it in detail. If presenting a popular or familiar concept, briefly and simply establish your case.

F. Results

This section should be about the final iteration of the prototype. It should include why your prototype is a viable solution for your client(s) and what the strengths are.

G. Recommendations

This section should include what your next steps are. If your prototype needs further development, what would you like to do? If your prototype is ready for production, what steps would you take to start the process? This sections should include language about the future and what you would do given more time to work on the prototype, or suggestions to help others who may continue to work on the project.

I. Appendix

Please be sure to also include here the following:

a. Data: The data should be clearly related to important design steps and improvements. It should include charts, graphs, tables, etc. with a brief explanation of the data (Title, labeled axis, etc.). Any equations you used should also be in this section is a description of the equation, labeled variables, and purpose.
b. Commented Arduino Code: What is the code that you used? Did you comment it so the reader can understand the variables and what they do, the different sections of the code and what they do, and what the outputs represent? Examples of Commented Code are included in this guide.
c. Detailed Budget Sheet: A sample budget sheet is included below. The budget sheet should help an investor understand the cost of parts for production. Receipts ARE NOT required.

J. Bibliography

All sources that are consulted should be properly cited according to either APA, IEEE, or another standard format. Please introduce all sources with a brief sentence explaining which format you chose and why.. We encourage you to seek at least eight (8) highly relevant sources that are appropriately formatted.

PROTOTYPE PITCH

In addition to the technical interview, teams will deliver a pitch for their solution. During the prototype pitch, teams will attempt to convince investors or management that their design meets the client's needs, is superior to other option available, and has business value as a product. The pitch should be engaging and informative. The judges will consider how well the team presents details of the prototype design, the design process, the impact of the prototype on the target user, and the overall quality of the presentation.

A goal of the Product Pitch is to "sell" your product to the judges. This summary is an approach to a marketing strategy that you may use to develop your Product Pitch.
(Source:smallbusiness.chron.com....edited for MESA)

The four Ps in marketing strategy are product, price, place and promotion. These are the four factors you must consider when you plan your marketing strategy. The four Ps are also known as the "marketing mix." To meet the needs of different customers or market sectors, you can change the mix by varying the product you offer, the price you charge, the place you sell it and the way you promote it.

Product

The right product is the one that meets the needs of your clients. You must carry out engineering design research to identify those needs and obtain feedback to ensure your product meets them. By monitoring product review sites you can assess how well your product performs compared to its competitors. Use your Engineering Design Notebook to help you improve different aspects of the product to improve performance. Adding more features that are important to clients, improving quality, changing the packaging or offering the product in different sizes or quantities are examples of changes that can make your product more appealing to your client.

Price

The price you set for your product must represent value to your customers. By comparing the price your competitors charge and the features they offer, you can assess whether your product offers greater value for money. You must also take account of changing prices in the market. You must calculate the projected sales so that you can maintain profit levels. Pricing decisions also cover the level of discount you offer to trade customers, such as retailers or distributors.

Place

To make decisions about place, you must understand where clients will buy your type of product. When you sell consumer products, you can distribute them through retail outlets, mail-order catalogs or the Internet. Geography is another factor to consider. You may decide to offer your products locally to minimize transportation costs or sell in other regions or other countries to take advantage of client demand.

Promotion

You must promote your product to make your client aware of it and build preference for your brand. You can promote your product through a variety of channels, including advertising, direct mail, website content, newsletters or press releases. To promote your product effectively, you must communicate the benefits that are most important to your client. Market research and your Engineering Design Notebook can help you identify the most important benefits.

Elements of the prototype pitch:

The prototype pitch consists of five elements: *Client Introduction and Problem Definition*, *Prototype Description*, *Prototype Demonstration*, *Business Value* and overall *Presentation Quality*.

Client Introduction and Problem Definition: The judges and audience should gain a clear understanding of the client and the problem that is being addressed. The presentation should include:

- Information about the client base including market size (population), market location, and market area.
- Impact of the problem on the client/end user.
- Specific information gained from the client about design requirements needed.
- Ways the problem is being currently addressed and weaknesses of these solutions.

Prototype Description: The judges and audience should gain a clear understanding of the team's prototype. The presentation should include:

- Discussion of what makes this design original or innovative.
- Discussion of how the design process (including testing) led to the prototype.
- Advantages of this prototype over existing solutions.

Prototype Demonstration: The judges and audience should gain a clear understanding of the functionality and usability of the prototype. The demonstration portion of the prototype pitch should include:

- Explanation of all features and functions of the prototype and how it meet's the client's criteria for look, feel, and cost.
- Demonstration of the functionality of the prototype and give evidence that it is easy to use.
- Next steps needed to bring the prototype to the client.
- Discussion of scalability and potential of the design as a product and/or in the current market.

Business Value: The judges and audience should gain a clear understanding of the value of the prototype as a product on the market. This section should include:

- An analysis of the market that demonstrates that your team understands the market and shows that the market is large enough to sustain business.
- A discussion of the price point for your product, how you determined this price point, and how your product is both competitive and profitable
- A discussion of a plan that will successfully advertise your product and reach the target market

Presentation Quality: The judges and audience should be engaged and informed by the prototype pitch. The presentation should include:

- Introduction of all team members and equal participation of all team members.
- Effective speaking practices (e.g., appropriate tone and pace, flow, volume, clarity, etc.)
- Body language that uses natural gestures and portrays confidence.
- Effective organization (i.e., strong and inviting introduction, focused and clear body, and effective and unifying closing)
- Content which demonstrates deep understanding of ideas, concepts, themes, and information related to the problem.
- Creativity and/or use of visual aids that contribute to a compelling presentation and keep the audience engaged

Teams are also encouraged to be creative and dynamic when presenting the prototype pitch. For instance, teams may choose to interact with the audience during the pitch. Remember, the goal is to convince investors or management that the team has a great, marketable idea. Teams are encouraged to use PowerPoint as part of the prototype presentation as well as video clips and other audio and visual aids.

HUMAN CENTERED DESIGN

Human-Centered Design is at the heart of this challenge. Identifying a client and researching their needs should be the first step a team takes. The client and their needs will then inform the entirety and be present in every step of the design process.

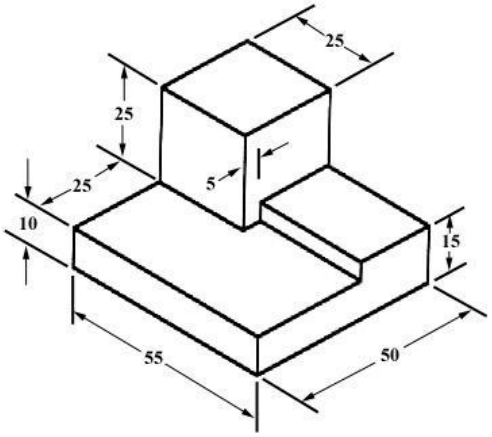
This may be a new approach to your MESA project so if you need assistance in understanding HCD and guidance in starting check out the following resources:

1. IDEO.org – A company with HCD at its core. Learn more about them and their approach.
2. IDEO's Design Kit – dig deeper into HCD with this kit.
3. Stanford's Design School Wallet Project – Project to help you practice HCD

ISOMETRIC & ORTHOGRAPHIC DRAWING SAMPLES

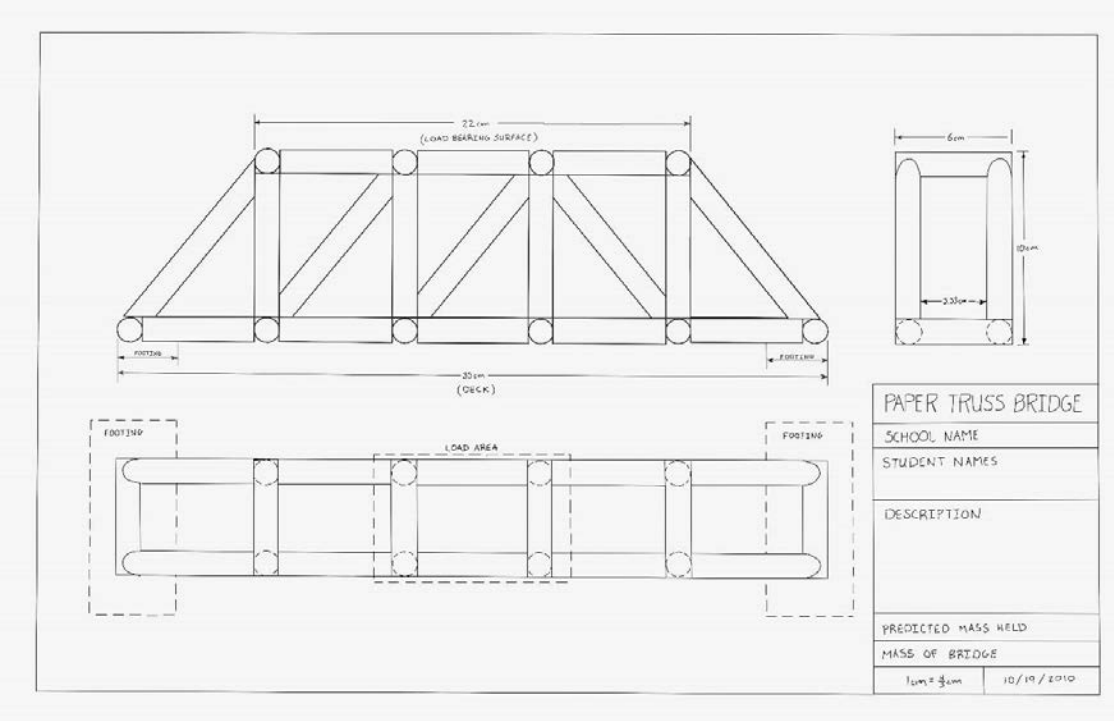
Isometric Drawing with Dimensions[1]

- For more information on how to create isometric drawings visit



http://www.me.umn.edu/courses/me2011/handouts/drawing/blanco-tutorial.html

Orthographic View[2]



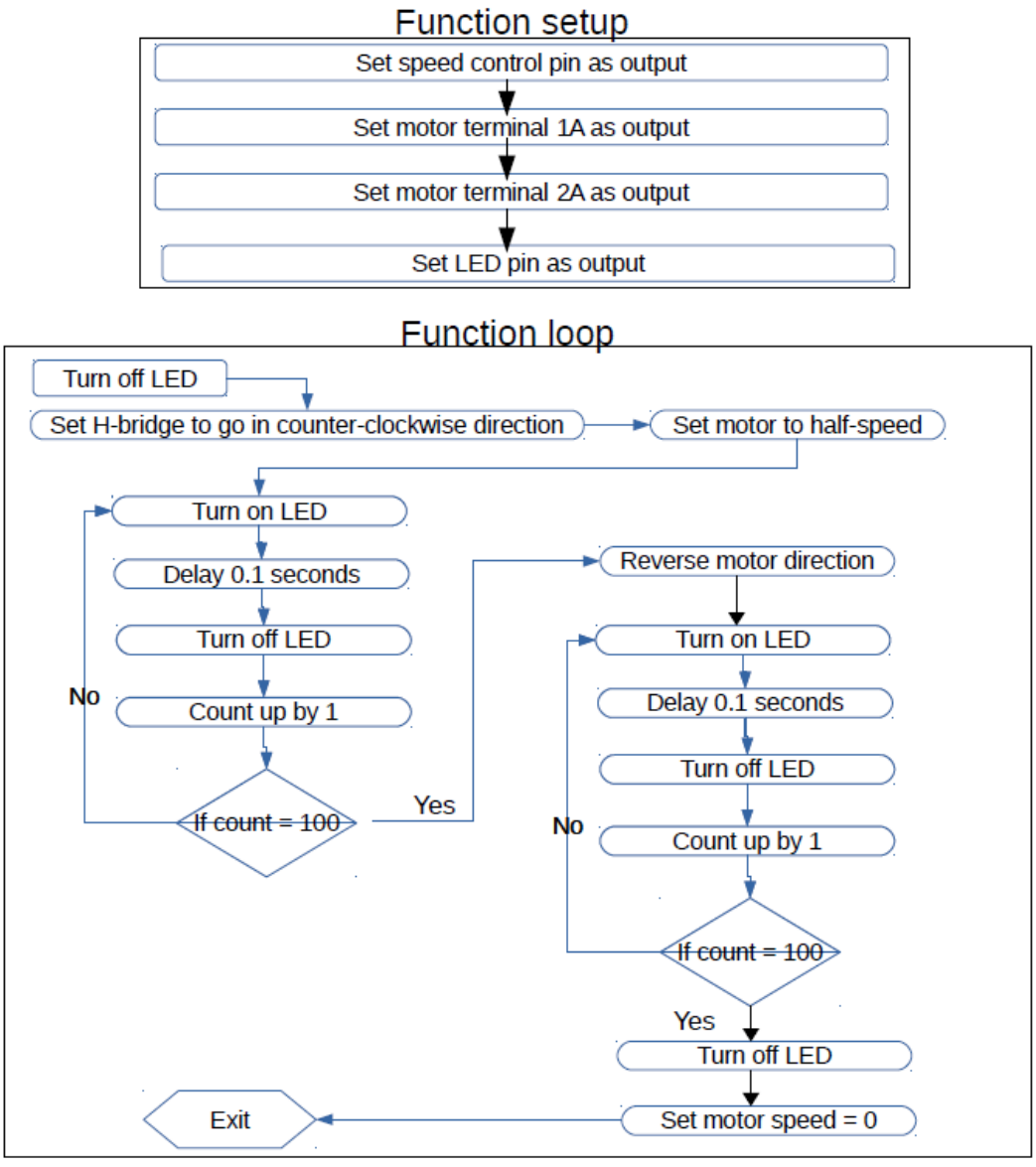
1. Blanco, Ernesto E., David G. Wilson, Sherodalyn Johnson, and LaTaunynia Flemings. "Engineering Drawing and Sketching." *Engineering Drawing and Sketching*. University of Minnesota Mechanical Engineering Department, n.d. Web. 25 July 2013. http://www.me.umn.edu/courses/me2011/handouts/drawing/blanco-tutorial.html .
2. Moriarty, Dylan. Paper Truss Bridge Drawing. Digital image. Arizona MESA, 26 Oct. 2010.

BLOCK LOGIC DIAGRAM SAMPLE

The logic shown demonstrates:

A. Configuring the Arduino input and output signals;
B. Driving the motor first in one direction for 10 seconds, and then reversing the motor direction for another ten seconds;
C. Turning the LED off and on during the running of the motor; and,
D. Exiting the program.

Note: This is only a sample. Please research and use a diagram design that makes sense to you and will be easy for others to follow.



COMMENTED CODE EXAMPLE

Everything after the "//" is a comment and not part of the code

```
// Solar Tracker
// Written by Michael Klements

# include < Servo.h>.

Servo tracker; // create servo object to control a servo
int eastLDRPin =0; // Assign analogue pins
int westLDRPin= 1;
int eastLDR=0; // Create variables for the east and west sensor values
int westLDR=0;
int error=0;
int calibration= 204; // Calibration offset to set error to zero when both sensors receive an equal amount of light
int trackerPos=90; // Create a variable to store the servo position

void setup ( )
{
        tracker. attach (11) ; // attaches the servo on pin 11 to the servo object
}
void loop ( )
{
eastLDR =calibration + analogRead (eastLDRPin) ; // Read the value of each of the east and west sensors
westLDR = analogRead (westLDRPin);
if (eastLDR<350 & & westLDR<350) // Check if both sensors detect very little light, night time
{
while (trackerPos<=160) // Move the tracker all the way back to face east for sunrise
        {
        tracker Pos++;
        tracker. write (tracker Pos);
        delay (100) ;
        }
}
        Error= eastLDR - westLDR; / / Determine the difference between the two sensors.
        if (error > 15) // If the error is positive and greater than 15 then move the tracker in the east direction
{
        If(trackerPos<=160) // Check that the tracker is not at the end of its limit in the east direction
{
        trackerPos++;
        tracker. write (trackerPos ); / /Move the tracker to the east
        }
}
else if (error<-15)   // If the error is negative and less than —15 then move the tracker in the west direction
{
        if (tracker Pos > 20) // Check that the tracker is not at the end of its limit in the west direction
        {
        trackerPos--;
        tracker.write (trackerPos) ;/ / Move the tracker to the west delay (100);
}
```

PSEUDOCODE SAMPLES

Pseudocode is an informal description of your programming logic. It should summarize and/or outline the program's steps and should not contain any code syntax or underlying technology considerations. **Most importantly it should make sense to you and be easy for others to follow.**

Below are examples of what pseudocode could look like for the program described in the Block Diagram sample on page 13.

Sample 1:

The "setup" function:
- Speed control is an output
- Motor terminal "1A" is an output
- Motor terminal "2A" is an output
- LED pin is an output
- Set motor_max_speed to 100*Note: maybe speed can take on a different value?*

The "main" function:
- Turn LED OFF then:
- Set H-bridge_dir to "counter-clockwise"
- Set motor speed to (motor_max_speed) * 0.5 *Note: half of my max speed*
- Set counter to 0
- IF counter does not equal 100 THEN:
  - Turn on LED
  - pause for 0.1 seconds
  - Turn off LED
  - Add 1 to counter
- OTHERWISE if counter equals 100:
  - *Note: whatever direction I'm in, go the opposite*
  - IF h-bridge_dir is set to "clockwise", set to "counter clockwise
  - OTHERWISE if its set to "counter clockwise", set it to "clockwise"
  - Set counter to 0
  - IF counter does not equal 100:
    - Turn on LED
    - pause for 0.1 seconds
    - Turn off LED
    - Add 1 to counter
  - OTHERWISE if counter equals 100:
    - Turn off LED
    - Turn off the motor
    - EXIT the program

Sample 2:

Set-Up Function
- Speed control is an output. Motor terminal "1A" is an output. Motor terminal "2A" is an output
- LED pin is an output. Set motor_max_speed to 100.*Note: maybe speed can take on a different value?*

Main Function
- Turn LED OFF. Set H-bridge_dir to "counter-clockwise." Set motor speed to (motor_max_speed) times 0.5 *Note: half of my max speed.* Set counter to 0. IF counter does not equal 100. Turn on LED. Pause for 0.1 seconds. Turn off LED. Add 1 to counter. OTHERWISE if counter equals 100. *Note: whatever direction I'm in, go the opposite.* IF h-bridge_dir is set to "clockwise", set to "counter clockwise. OTHERWISE if its set to "counter clockwise", set it to "clockwise." Set counter to 0. IF counter does not equal 100. Turn on LED. Pause for 0.1 seconds. Turn off LED. Add 1 to counter. OTHERWISE if counter equals 100. Turn off LED. Turn off the motor. EXIT the program

ITEMIZED BUDGET SHEET SAMPLE*

MESA Center:_____ MESA School: _____

Level: MS HS Advisor/Teacher:_____

Student Team:_____

Part	Unit Dimensions	Retail Price	Price per Unit	Quantity Used	Total Cost	Retail Source	Receipt
6061 Aluminum flat	*1/8" x 1/2" x 24"*	*$1.98/flat*	*$0.0825/inch*	*10 inches*	*$.0.82*	*Metalsdepot.com*	*1*
Masking Tape	*1 inch x 60 yards*	*$4.02*	*$0.0019/inch*	*12 inches*	*$0.02*	*TheSupplyTree.com*	*2*
TOTAL COST							

***** A spreadsheet that will automatically calculate the budget has been created and is available for teams to use. Contact your state representative or visit the MESA USA website for a copy.

QUESTION AND FEEDBACK PROCESS

When asking for clarification on the National Competition Rules or for any other question about the National Competition the following process will be used:

1. Teams must contact their state representative via email (see the list below).*
2. If possible, the state representative will respond via email. This question and the response will also be provided to other schools within that state.
3. If necessary, the representative will contact the National Rules Committee to discuss the question. The committee's decision will be relayed to all states for public distribution and the question will be listed on the national FAQ list on the MESA USA website (MESAUSA.ORG).

* Questions sent directly to the National Rules Committee will be rerouted to the state representative.

State Representatives:

- Arizona – Manny Leon (leon@arizona.edu) or Bill Pike (wpike@email.arizona.edu)
- California – Carlos Gonzalez (carlosg@engr.ucr.edu)
- Colorado – contact National Committee at nationalcompetition@mesausa.org
- Illinois – contact National Committee at nationalcompetition@mesausa.org
- Maryland – Jason Cartwright (jason.cartwright@jhuapl.edu)
- New Mexico – Anita Gonzales (anita@nmmesa.org)
- Oregon – Tamara Depue (tdepue@cecs.pdx.edu)
- Pennsylvania – Jesus Davalos (tug64370@temple.edu)
- Utah – Dr. Paul Ross (buffyross@msn.com)
- Washington – Debbie Blas (Debbie.blas@wsu.edu)