Title: Software Engineering Extravaganza	1

We chose to participate in the Software Engineering Extravaganza. These are the requirements and rules for the competition.

➔ **This is step 1 in the Engineering Process: Define the Problem**

Design Statement and Objective

Prior to the competition, use the provided basic programmable logic controller to create a unique
automated display using visual and audio components that is triggered via a physical input.
The overall objective is to create an entertaining automated show. For example, a model home
holiday display with light and sound. Code should be well documented, readable and bug free.
Code should incorporate SOLID principles when practical

Requirements

- Max dimensions of the completed display are 3ft x 3ft x 3ft.
- There needs to be an interactive trigger to start the display.
- There needs to be the ability to pause the display. Pause will stop the show and pushing start will continue from where the display was paused.
- There needs to be the ability stop the display. Stop will end the show and pushing start will re-start the show from the beginning.
- There should be a minimum of one motion component, one light component and one sound component in the display.
- The show must be a minimum of one minute and a maximum of five minutes.
- The model creation and the programming must be completed by members of the team.
- Upload code and supporting documentation to a public GitHub repository and provide the link to OEF by Feb. 19. Supporting documentation should include but is not limited to:
    - o A design document explaining the logical operation and physical construction of your display
    - o Parts list including source and cost of materials used

Signature: Date:	Team Members: ↓
Witness: Date:	TRISTIE NGUYEN SOPHIA CLANTON CARSON WOLKE MATTHEW SMITH BRODY JOHNSTON
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This is our Team!

This is Sophia! Our Recorder

Sophia helped with the notebook, decorating the display, research, 3D printing, planning, painting the decorations and designing the display.

This is Tristie! Our Leader

Tristie helped with CAD, notebook, decorating the display, research, planning, designing, editing the music and painting the base and decorations.

This is Matthew! Our Builder

Matthew helped with CAD for the base and display, wiring, 3D printing, lights, mechanics, soldering, planning, and building the base and display.

This is Carson! Our Logical Thinker

Carson helped with the research, coding, mechanics, cading, planning, wiring, designing, lights, soldering, converting sound files, speaker, and writing the script.

This is Brody! Our Programmer

Brody helped with the coding, recording script, editing the sound, and the notebook.

Although we all have different roles and responsibilities, we still work all together. We often piggyback off of each other. We also chose roles base on our strengths and weaknesses.

Signature: Date:	Team Members: ↓
Witness: Date:	TRISTIE NGUYEN SOPHIA CLANTON CARSON WOLKE MATTHEW SMITH BRODY JOHNSTON
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This is our materials list. Our total cost is $93.87.

➔ **This is all of our materials and cost.**

Materials For Base

- 1 sheet of 4’ x 6’ x 3/4” plywood ~ repurposed
- 1 sheet of 4’ x 4’x ¼” pine plywood ~ $18.98
  https://www.lowes.com/pd/ReliaBilt-1-4-in-x-4-ft-x-4-ft-Pine-Sanded-Plywood/5002094207
- Apple Barrel Acrylic Craft Paint, Matte Finish, White, 32 fl oz ~ $9.57
  https://www.walmart.com/ip/Apple-Barrel-Acrylic-Craft-Paint-Matte-Finish-White-32-fl-oz/36502452?wl13=4195&selectedSellerId=0
- Colored paint ~ repurposed
- Lamp post ~
- 3D parts ~ printed and repurposed filament
- Window motor ~ repurposed

Materials For Display

- 1 sheet 4’ x 8’ x ⅛” plywood ~ repurposed
- Battery pack ~ $9.99 ~ https://a.co/d/iTvr7Kl
- Amplifier ~ $9.99 ~ https://a.co/d/iYCEb8x
- SD card ~ $8.89 ~ https://a.co/d/c0tUygw
- Wires ~ $6.98 ~https://a.co/d/cdR9lnM
- LED Light ~ $11.99 ~ https://a.co/d/40KqW30
- Resistor ~ $5.49 ~ https://a.co/d/imHZz67
- Speaker ~ $11.99 ~ https://a.co/d/f620dSY
- 3D parts ~ printed and repurposed filament
- Bearings ~ repurposed
- Cardboard ~ repurposed
- Paint ~ repurposed
- Clay ~ repurposed
- Mini people ~ repurposed
- Mini trees ~ repurposed

These are our brainstorming ideas for the theme of our Display.

➔ **This is Step two of the Engineering Process: Generate Concepts**

Themes

- Aladin
- SpongeBob
- Landrun
- Forest Fire
- PLC Project Process
- Hungry Caterpillar
- Amelia Earhart
- Band Forming
- Ben Franklin Flies a Kite
- Bohemian Rhapsody
- Star Wars
- Revolutionary War

- The Beatles
- Orchestra
- Apollo 13 Explosion

Decision Matrix

We used a decision matrix to rate and decide which theme would work the best for our project

	cost	build complexity	code complexity	apeal	time	enjoyability	importance		
aladin	2.5	1	2.5	2.5	1	2	1	12.5	
spounge bob	4	1	1	1	1	1	1	10	
landrun	2.5	3	2	3	3	2.5	2.5	18.5	
forest fire	2	1	2.5	1	1	1	1	9.5	
plc project process	2	1.5	2	1.5	1	2	1	11	
hungry catipilar	3	3	4	1	3	1	1	16	
Amilia Earheart	2	2	1.5	2.5	2.5	2.5	3	16	
band forming	1.5	2	2	2	2	3	1.5	14	
Ben Franklin flies a kite	3	2.5	3.5	3	2.5	3	3.5	21	
Bohemian Rhapsody	1.5	1.5	1.5	3	2.5	3.5	2.5	16	
StarWars	2	2	1	2.5	2	2.5	2	14	
Revolutionary War	1.5	1.5	2	2	1.5	2	3	13.5	
The Beatles	3	2.5	2.5	3.5	2	4	2	19.5	Final Choice
Orchestra	3	1	3	3	1	3	1.5	15.5	
Apollo 13 explotion	2.5	3	3.5	3	2.5	3	3	20.5	
best			worst		yes	no			
4	3	2	1		2	1			

Signature: Date:	Team Members: ↓
Witness: Date:	TRISTIE NGUYEN SOPHIA CLANTON CARSON WOLKE MATTHEW SMITH BRODY JOHNSTON
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Title: Software Engineering Extravaganza	5

This is our idea for our display! We choice the theme of our display to be about The Beatles!

➔ **<u>This is the 3rd step of the Engineering Process: Develop a Solution</u>**

When we first started to Brainstorm we all thought of different ideas to display the history of The Beatles.

- ★ At first we thought of doing just a light show of one of their music videos.
  - Then we realise it would take too many lights and not have a motor so we chose not to do that.
- ★ Then we had an idea to include the Abbey Road into our design and thought of having The Beatles walking in a circle around a platform.
  - We realised that there would be no story in that and would not be longer than a minute.
- ★ We decided that we should do a story over the history of how The Beatles got together and have The Beatles circling around that.
  - We thought that it would be too complicated to have The Beatles move and would not work with another object on the platform as well.
- ★ We then decided that we should have a rotating box that shows different scenes of The Beatles showing the importance of their career and the impact they made on music, We also really wanted to represent The Beatles album “Abbey Road”
  - During this time of Develop we had troubles staying on the same page and getting confused with each other. So we made sure that every time we were confused we made sure to stop and talk about it either at school or over the phone at home. We would sketch out different ideas and talk step by step in order to make sure everyone understood the topic.

Signature: Date:	Team Members: ↓
Witness: Date:	TRISTIE NGUYEN SOPHIA CLANTON CARSON WOLKE MATTHEW SMITH BRODY JOHNSTON
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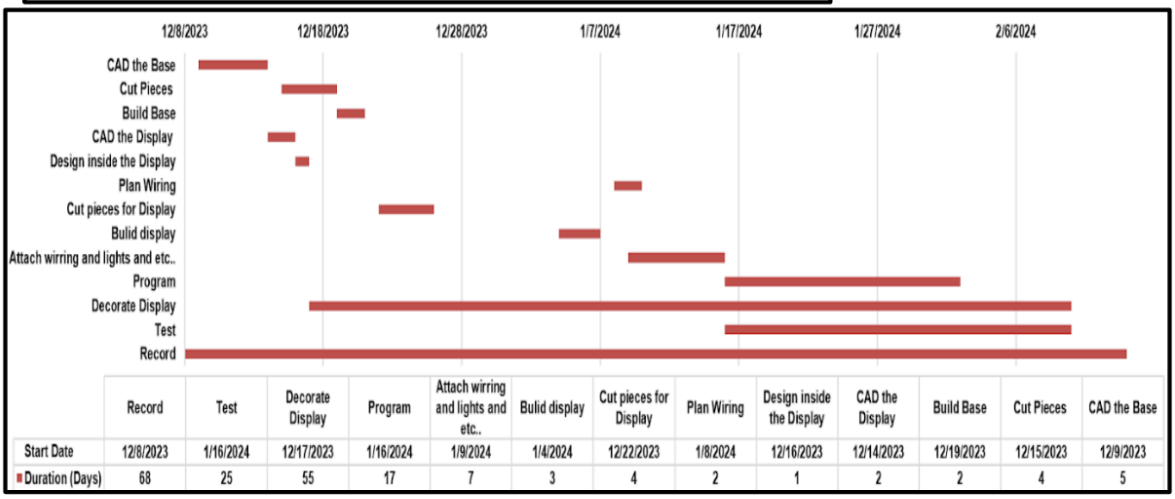
This is the Gantt Chart that we made in order to stay on schedule.

➔ **<u>This is Step Three of the Engineering Process: Develop a Solution</u>**

Tasks	Start Date	End Date	Duration (Days)
CAD the Base	12/9/2023	12/14/2023	5
Cut Pieces	12/15/2023	12/19/2023	4
Build Base	12/19/2023	12/21/2023	2
CAD the Display	12/14/2023	12/16/2023	2
Design inside the Display	12/16/2023	12/17/2023	1
Plan Wiring	1/8/2024	1/10/2024	2
Cut pieces for Display	12/22/2023	12/26/2023	4
Bulid display	1/4/2024	1/7/2024	3
Attach wirring and lights and et	1/9/2024	1/16/2024	7
Program	1/16/2024	2/2/2024	17
Decorate Display	12/17/2023	2/10/2024	55
Test	1/16/2024	2/10/2024	25
Record	12/8/2023	2/14/2024	68

Start Date Conversion	45268
End Date Conversion	45336
2/15/2024	45337



	Record	Test	Decorate Display	Program	Attach wirring and lights and etc..	Bulid display	Cut pieces for Display	Plan Wiring	Design inside the Display	CAD the Display	Build Base	Cut Pieces	CAD the Base
Start Date	12/8/2023	1/16/2024	12/17/2023	1/16/2024	1/9/2024	1/4/2024	12/22/2023	1/8/2024	12/16/2023	12/14/2023	12/19/2023	12/15/2023	12/9/2023
Duration (Days)	68	25	55	17	7	3	4	2	1	2	2	4	5

As a group, we decided the due dates and the schedule for each task. We assigned tasks to each person/pair in order to follow the schedule.

Matthew, Sophia, and Tristie made the Gantt Chart with the input of Brody and Carson.

Matthew was task with the CAD, building, cutting pieces, mechanics, and wiring. Carson and Brody worked on the program, wiring, lights, mechanics speaker, and planning. Tristie and Sophia did the recording, decorating, and designing the inside of the display.

Signature: Date:	Team Members: ↓
Witness: Date:	TRISTIE NGUYEN SOPHIA CLANTON CARSON WOLKE MATTHEW SMITH BRODY JOHNSTON
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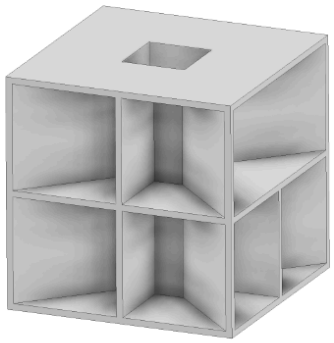
Design Process

➔ **This is the 3rd step of the Engineering Process: Develop a Solution**

This is first version of the Display Box and Display Base CAD.

- Before coming up with our final design, we had a couple of different ideas that we came up with.

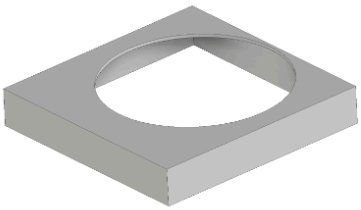
This is one of our first designs we came up with.

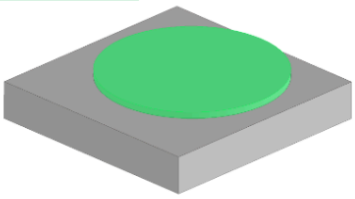


This design was originally supposed to be made with plywood. But when we decided we were going to use a laser cutter to cut our pieces, we decided to use a different material.

This is the design for our base. We first thought about having the circle in the center but after brainstorming ideas for our concept we decided to leave room on the front for decorations.

The circle in the center is where our display will sit.





Signature: Date:	Team Members: ↓
Witness: Date:	TRISTIE NGUYEN SOPHIA CLANTON CARSON WOLKE MATTHEW SMITH BRODY JOHNSTON
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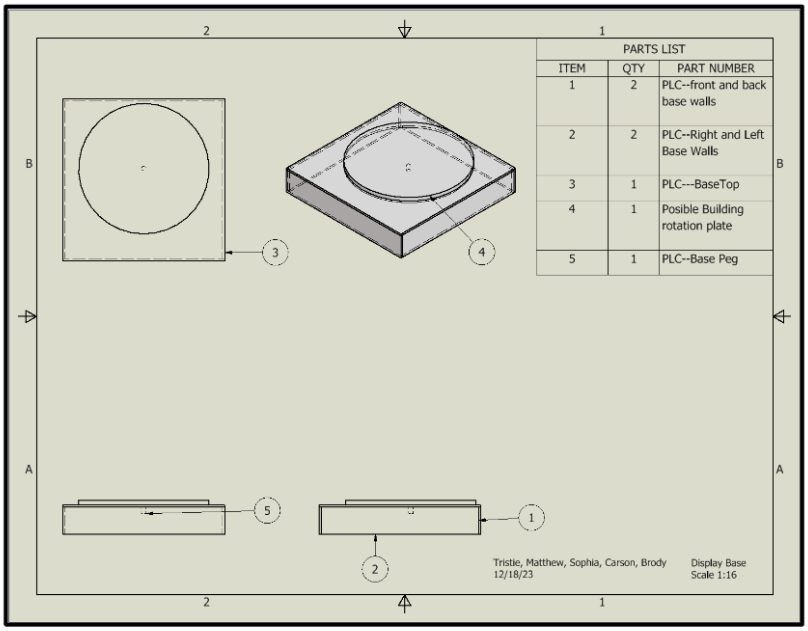
CAD For The Display

➔ **The 4th step to the Design Process is Conducting and testing the prototype**

This is the final design for the base

We decided with a square base in order to have space for the motor and wires. We used a circle top to place the display on the base and be able to have it be detachable. We wanted it to be detachable to allow transport to be more easy and allow less errors to occur. The circle is use to rotate the display as it would be the best shape to rotate. We also chose to have the circle be off center so we could add decorations to the front of the base

This is our CAD drawing of the assembly of the base. After a lot of adjusting and discussing the measurements we finalized this design. It allow us to have a strong base to hold everything and still be able to transport everything.



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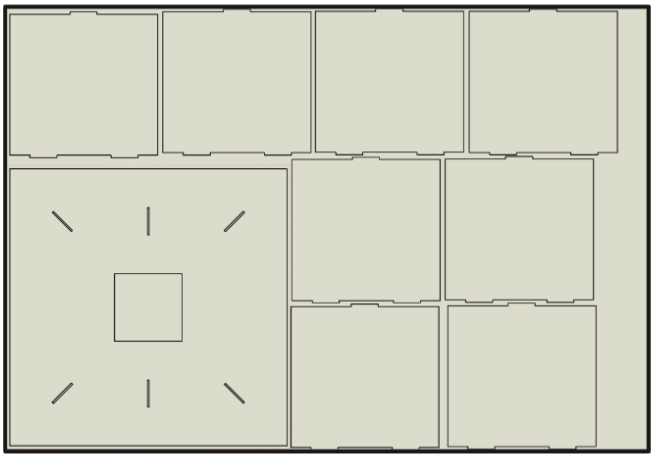
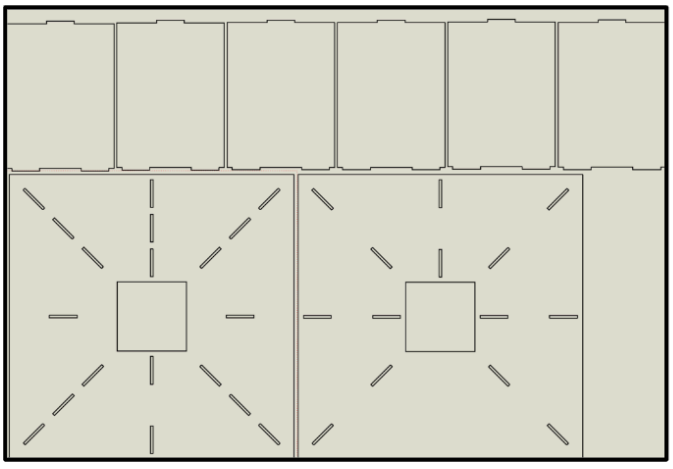
CAD For The Display

➔ **The 4th step to the Design Process is Conducting and testing the prototype**

This is the final design for the display

This is the layout of each piece of the display. It is layout like this in order for us to use a laser cutter. At first we were going to use ¼ inch thick plywood to build the display. We decided against due to weight, difficulty, and time. So we chose to use a laser cutter in order to use a thinner wood, and save time.





Signature: Date:	Team Members: ↓
Witness: Date:	TRISTIE NGUYEN SOPHIA CLANTON CARSON WOLKE MATTHEW SMITH BRODY JOHNSTON
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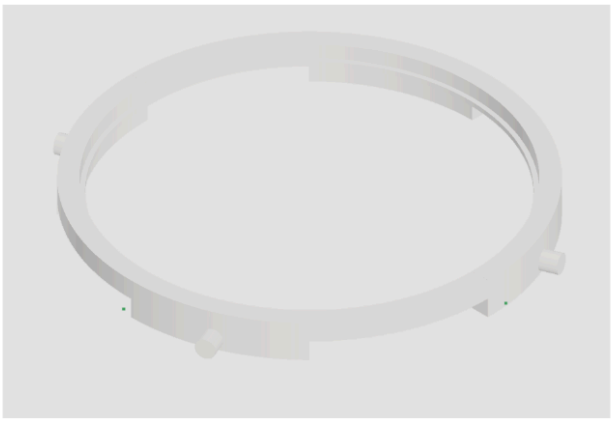
CAD For The Display

➔ **The 4th step to the Design Process is Conducting and testing the prototype**

This is the design for the mechanics

This is the design for the rotation device. It was made in CAD and 3D printed
The rotation ring:
In basic terms it \jjj\is a lazy susan. It will hold the motor, support, and spin the display with four wheels (not shown in assembly) attached to the side of the ring.



This is the wheels to move the ring. It was made in CAD and 3D printed.The wheels that will be attached to the rotation ring. The divot is designed for hot glue to be placed for extra rubberized traction.Inside of the wheel is a bearing in order for it to move more smoothly.

Signature: Date:	Team Members: ↓
Witness: Date:	TRISTIE NGUYEN SOPHIA CLANTON CARSON WOLKE MATTHEW SMITH BRODY JOHNSTON
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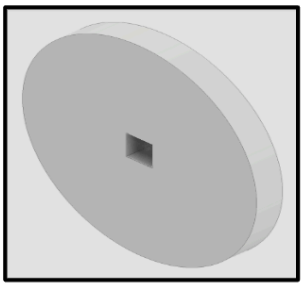
CAD For The Display

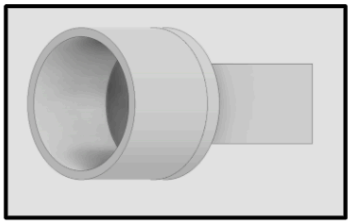
➔ **The 4th step to the Design Process is Conducting and testing the prototype**

This is the design for the mechanics

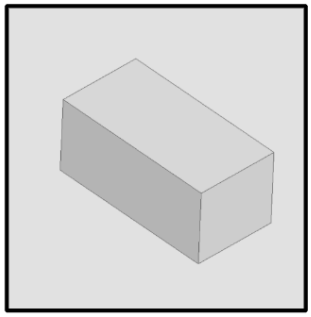
Motor Ground Circle:
This will be attached to the bottom of the base. It will ground the motor so when it's attached to the rotation ring, it spins the ring and not itself. The square cutout is for the motor adapter to connect to (shown below).



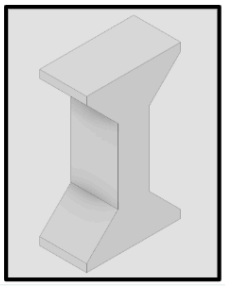
Motor Adapter:
The adapter will be attached to the motor to connect it to the Ground Circle.



The Motor Shim:
This is a very improvised way to keep the motor level on the rotation plate. It will sit under the heaviest part of the motor to support it.



Rotation Supports:
These 3 supports will be connecting the rotation ring to the rotation plate. Both ends will be hot-glued.



Signature: Date:	Team Members: ↓
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Design Process

➔ **The 4th step to the Design Process is Conducting and testing the prototype**

With most of our code finished, we were able to start attaching the motors to our display and start testing to see if the code worked.

```
# Define the pins, leds, motor, speaker, and buttons.

import machine
from time import sleep
led1=Pin(1,Pin.OUT)
led2=Pin(2,Pin.OUT)
led3=Pin(3,Pin.OUT)
led4=Pin(4,Pin.OUT)
led5=Pin(5,Pin.OUT)
led6=Pin(6,Pin.OUT)
led7=Pin(7,Pin.OUT)
led8=Pin(8,Pin.OUT)
led9=Pin(9,Pin.OUT)
led10=Pin(10,Pin.OUT)
led11=Pin(11,Pin.OUT)
led12=Pin(12,Pin.OUT)
led13=Pin(13,Pin.OUT)
motor1a=Pin(14,Pin.OUT)
motor1b=Pin(15,Pin.OUT)
speaker=Pin(16,Pin.OUT)
button1=Pin(17,Pin.OUT)
button2=Pin(18,Pin.OUT)

# Set the program to start when you press the button
if button1.value():
# Play the intro with no lights for 10 seconds
# Play the lights and audio.
    led1.value(1)
    print(led1)
    sleep(10)
    led1.value(0)
    print(led1)
```

```
# Spin the motor 90 degrees, then repeat the last section.
    motor1a.high
    motor1b.low
    sleep(3)
    motor1a.low
    motor1b.low

    led4.value(1)
    print(led4)
    sleep(21)
    led4.value(0)
    print(led4)

    led5.value(1)
    print(led5)
    sleep(18)
    led5.value(0)
    print(led5)

    led6.value(1)
    print(led6)
    sleep(21)
    led6.value(0)
    print(led6)
```

The above text codes for making our display rotate clockwise. The left text codes for calling all of the variables and playing the lights for a certain amount of time.

Signature: Date:	Team Members: ↓
Witness: Date:	TRISTIE NGUYEN SOPHIA CLANTON CARSON WOLKE MATTHEW SMITH BRODY JOHNSTON
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Rules

➔ Judging and Scoring

Judging and Scoring

1. Prior to the competition, each display will be inspected by the judges to determine compliance with the contest requirements and specifications.
2. Any project that does not meet the above requirements will be ineligible for prizes.
3. Each team is responsible for the security of its entry. No time will be spent looking for or waiting for teams that are not present when it is their turn. Teams not present will go to the end of the queue if time permits.
4. Decisions of the judges are FINAL.
5. The competition area will be off limits to everyone except the competitors and officials.
6. Each team is responsible for providing batteries, supplies and tools as required.
7. This display will be judged on the following criteria and rubric:
   - Creativity
   - Quality of finished product
   - Code Quality

Creativity	Weight	Score (1-10)
General	10%	
Complexity of Show	15%	

Quality of Finished Product	Weight	Score (1-10)
Physical Display	15%	
Design Documentation	10%	

Code Quality	Weight	Score (1-10)
Well Documented	15%	
Readability	10%	
Bug-Free	10%	
SOLID Principles	20%	

Total Score	

Title: Software Engineering Extravaganza	14

Team

➔ Team Working Together

Signature: Date:	Team Members: ↓
Witness: Date:	TRISTIE NGUYEN SOPHIA CLANTON CARSON WOLKE MATTHEW SMITH BRODY JOHNSTON
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