Path of Lights and Sounds
Tagalong Trail

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Acknowledgements:

Sarah Harding – Project Advisor

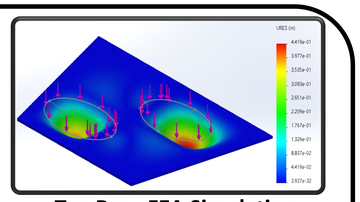
STRUCTURAL OBJECTIVES

- Capable of supporting children and adults (up to 300 lbf)
- Easy to manufacture and assemble
- Even light distributions and diffusion
- Safe and portable

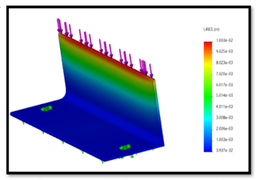
Jumping on Tile

STRUCTURE ANALYSIS

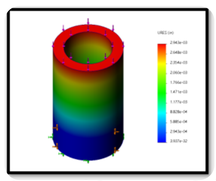
- The top surface analysis showed the need for supports
- The support design went through 2 iterations, the first version is a 90° aluminum angle which is not stable and created dark shadow lines
- The second version is UHMW modified rod that can withstand the load evenly and allow light through



Top Base FEA Simulation



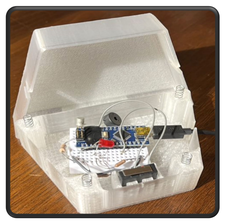
Internal Support v1



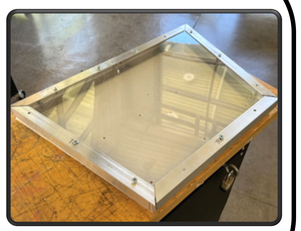
Internal Support v2

PROTOTYPES

- Conceptual Prototype proved that the design is valid and aesthetically pleasing
- The Structural Prototype showed the team that acrylic did not diffuse lights well, and how difficult manufacturing is



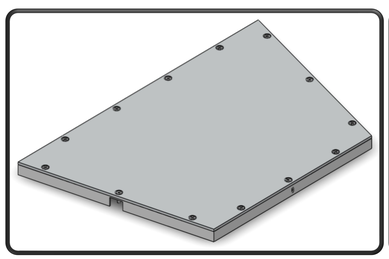
Concept Prototype



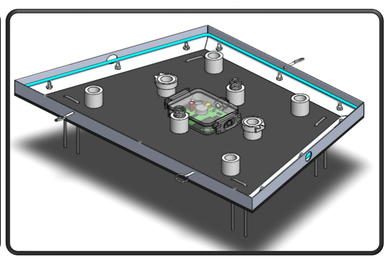
Structural Prototype

FINAL TILE DESIGN

- Top Assembly
  - UHMW 90° angle frame
  - White HDPE top sheet
  - Clear grip tape
- Bottom Assembly
  - Aluminum 90° angle frame
  - Recycled HDPE bottom sheet
  - Electronics
  - UHMW rod supports



CAD Isometric View of Top Assembly



CAD Isometric View of Bottom Assembly

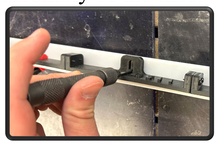
OVERALL PROJECT OBJECTIVE

- Create a light-up, musical path that is interactive for a themed Christmas event (and possibly other events)
- Event starts on December 1st (today!)
- Needs to survive outdoors, get power from a generator outlet, and be easily set up

MANUFACTURING & ASSEMBLY

- The manufacturing of all 28 tiles proved to be a larger challenge than the team foresaw. After over 300 combined hours of work, the tiles came together, and with a few minor adjustments, worked wonderfully. Thank you to all the girl scouts who helped with the assembly of the tiles.

Cutting Supports

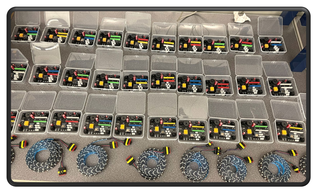


Marking Sides

Aluminum Base Fitment

Water Jet Bases

Assembling Base



Tile Electronics Assembly

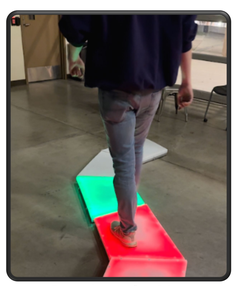
Girl Scouts Assembly Day

CONCLUSIONS

- After all the effort put into this project, the group is proud of what they have accomplished
- The attraction is capable of being used for several different types of events
- After manufacturing all 28 of the tiles, the group has found several changes that should be made before trying to make more
- Many lessons were learned about manufacturability, workload, engineering obligations, and working within an external customer's wishes

Girl Scouts on Tile

Full Path Assembly



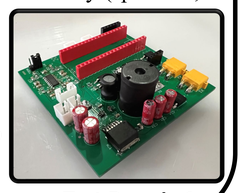
Product in Use

ELECTRONICS OBJECTIVES

- Infrastructure to easily program new song to the tiles
- Play sounds through a speaker, loud enough to be heard
- Change LEDs to any color, be able to communicate song timing

TEST BOARD V1

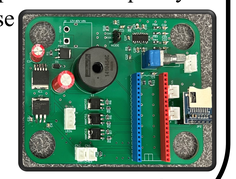
- Implement basic circuitry
- Test raw functionality (speakers, lights, and UART)
- No specific layout
- Uses a Pico (RP2040) MCU



Test Board v1

TEST BOARD V2

- Added noise filtering and volume control to improve sound quality
- Improved ease of assembly
- Considered layout and connector usage



Test Board v2

FINAL BOARD & ELECTRONICS

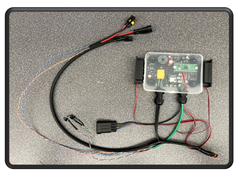
Electronics

- Removed volume control (unnecessary)
- Add more filtering to improve sound quality
- Further improve ease of assembly and layout
- Added test point and power clip locations
- Added mounting holes for rubber stops

Enclosure

- Sealant ring around the rim for water resistance
- Two cable glands to pass through all wires
- Electrical tape, heat shrink, and waterproof connectors for water resistance
- Velcroed speakers and enclosure to the tile

Final Board



Electronics Assembly

KEY TESTS & RESULTS

- Testing was conducted to cover several aspects of the tile, ranging from manufacturing to the end-product's function
- Overall, 7 tests were conducted and the results are cataloged below

Test Name	Purpose	Criteria	Result	Pass/Fail
Friction Test	User traction	$\mu \geq 0.5$	1.20	Pass
Impact Protection Test	Early detection of long-term damage	No detrimental damage	Light scratching due to internal supports	Pass
Kick Test	How well the tile is fixated to the ground	25 "kicks" moves tile <1in	Staked down: 3/8" No stakes: 5/4"	Staked down: Pass No stakes: Fail
Manufacturing Time	Manufacturability for future reproduction	1 tile made in ≤ 8 hours	w/ electronics: 10.58 hrs w/o electronics: 4.25 hrs	w/ elec.: Fail w/o elec.: Pass
Decibel Test	Loudness of the tile	Sound produced ≥ 80dB	83.22 ± 4.71 dB	Pass
Maintenance Time	Serviceability of the tile for upkeep	Dis/Re-assembly time ≤ 10 min	33 minutes and 42 seconds	Fail
Consumer Feedback	Tile's appeal in terms of public opinion	Rating ≥ 4 stars	4.55	Pass

Special thank you to **Emily Laing**