Tesla Candy Bowl

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Sponsor: Dr. Ward
Advisor: Dr. Brakora

BACKGROUND

Dr. Ward, of GVSU, is the Sponsor who commissioned a Tesla Candy Bowl showpiece that makes engineering exciting, hands-on, and approachable while encouraging curiosity about electrical and mechanical engineering design.

OBJECTIVE

To design and build a safe, durable, and interactive Electrical Engineering demonstration that uses invisible concepts such as analog, 24V DC capacitance, high voltage, vacuum tube, operational amplifier circuits, flyback transformer, LED Matrix, etc. to serve as an interactive candy bowl visibly and audibly produces output in relation to users as they reach for candy.

MECHANICAL SPECIFICATIONS

- Total weight < 25 lbs.
- Clear enclosure with visible electronics
- 3D printed PLA sheet
- 80/20 Aluminum reinforcement
- ANSYS simulations

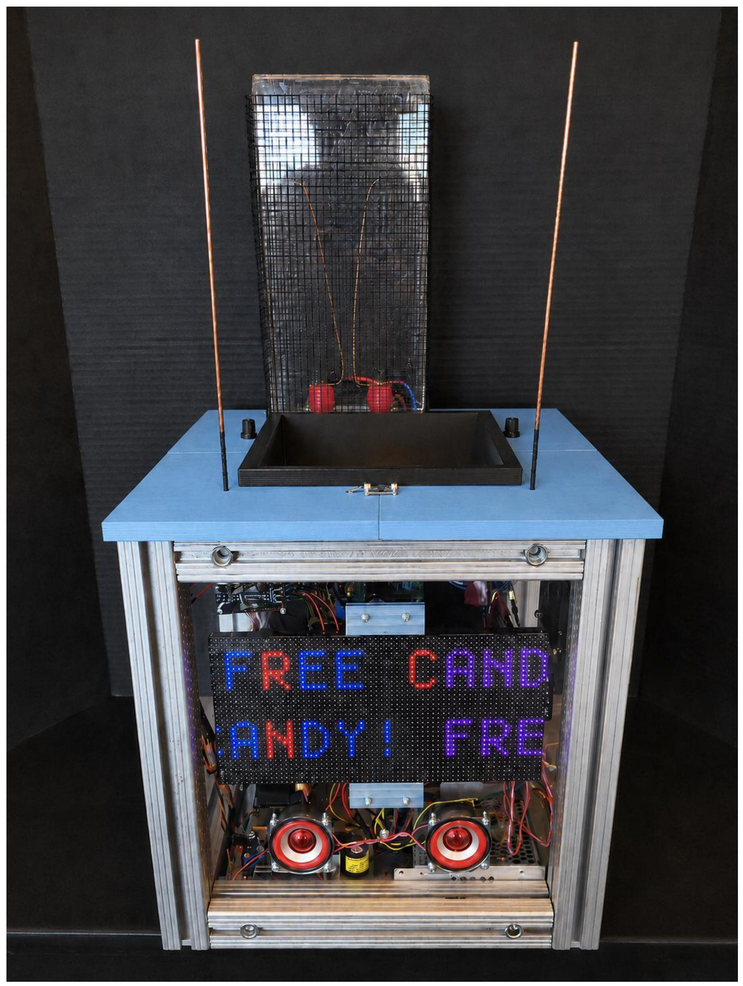
DESIGN CHALLENGES

- Safely enclosing the high voltage Jacob Ladder
- Detection of small changes in capacitance with hand motion
- Minimizing electrical noise and interference
- Maintaining structural integrity with accidental impact
- Integrating mechanical, analog, audio, visual, and high voltage

ACHIEVEMENTS

- Created an interactive Electrical Engineering outreach demonstration
- Integrated analog capacitive sensing with real time audio and visual feedback
- Safely incorporated high-voltage visual effect
- Designed, built, and tested a transparent enclosure that showcases electronics
- Validated design via simulations and physical testing

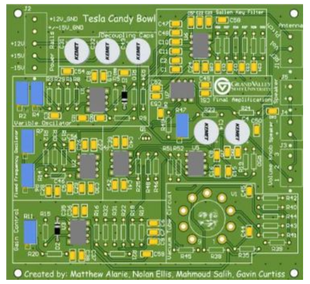
TESLA CANDY BOWL

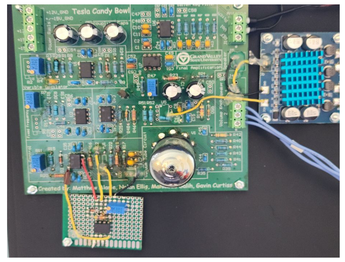


ELECTRICAL

THEREMIN

- Separate capacitance-sensitive antenna circuits
- Op-amp-based oscillators
- Signal mixing for pitch control and conditioning
- Diode suppression and filtering for volume sensitivity circuit to convert hand-induced capacitance changes into a stable control voltage output
- Audio signal then passes through a vacuum tube for tone and amplification
- Repeats with next motion





JACOBS LADDER

- 24V DC to a zero-voltage switching circuit and flyback transformer to generate high voltage
- Boosted voltage of 10,000-15,000V ionizes surrounding air between two diverging electrodes
- Air heats creating a plasma arc that rises as air is heated until gap is too large and is extinguished
- Repeats with motion

LED MATRIX

- MatrixPortal M4 controller programmed in Python using distance readings from the VL53LOX LiDAR sensor to increment a series of flag variables: No detection, close range detection, withdrawal detection, and idle mode to promote interest
- Potentiometer to independently control display brightness

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