

Designing an Innovative Fog Generation System

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System Requirements and Specifications

- An innovative fog feature was designed and integrated into the back glass of a restored vintage pinball machine.
- The designed system produces fog instantaneously through the use of a unique atomizer design using a common source reservoir supplying multiple vaporization wicks.
- The prototype features an exhaust system capable of manipulating and removing fog within the containment unit.
- The prototype is controlled through a programmable microcontroller allowing it to operate autonomously in response to triggers from pinball machine.



Figure 1: The image on the right is a diagram of the components of an electronic atomizer. The green section is the wick fabricated from a rolled stainless steel mesh. The light blue helix is the heating element, which heats the coil once a current is introduced through the lead screws. The grey section is the reservoir that contains the liquid that will be vaporized. The image on the left is the actual product represented by that diagram.

Testing

Fog Production

- Testing different fog production methods determined that atomizers were the optimal way to create a vapor substance.
- Figure 5 compares how well different fog devices met design specifications.

Containment System

- Through testing it was discovered that the best material for construction was acrylic plastic and the best bonding agent was a clear plastic epoxy.

Exhaust Process

- In order to exhaust the vapor out of the containment system, computer fans were used to manipulate and exhaust the fog.

Cleaning Process

- The method chosen to best clean the container used an hydrophobic solution to cover the inside of the container to reduce the staining caused by the fog vapor, and then using a physical mechanism to clean and reapply it.

Problem Statement

Fog Production

- Fog production within a short period of time - approximately five seconds.
- Fog in the back glass visibly appealing without obstructing the images.
- Three fog states: low, medium, and full.
- Figure 3 is a SolidWorks® rendering of the finalized fog production system.

Containment

- Containment fixture for purposes of holding the fog that occupies space in the back glass of the pinball machine, between two acrylic sheets of artwork.
- Fixture made of a transparent material to make the best use of the fog.
- Containment system integrates easily with the preexisting space of the machine.
- Figure 2 is a SolidWorks® rendering of the finalized design.

Exhaust Process

- A fog exhaust system was required.
- Fog vented from the containment fixture between five and ten seconds.
- Fog spills out at the player's feet from the pinball machine.

Cleaning Process

- Cleaning system for the mechanism was specified.
- Cleaning system designed such that the fog-containment fixture need not be removed from the pinball back glass.

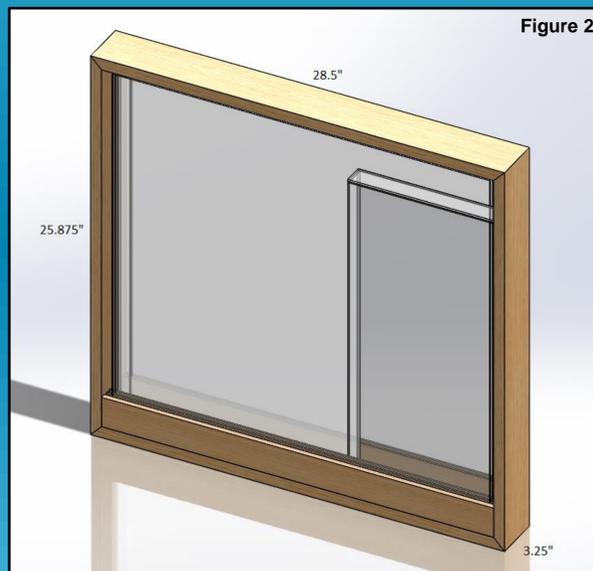
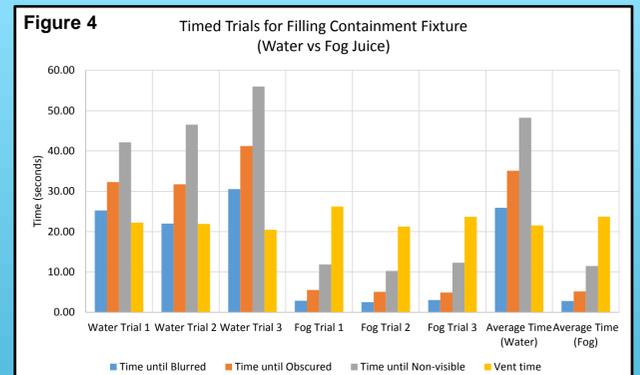


Figure 2

Data/Observations

Conclusions

- Through extensive testing, liquid fog solution was determined to best fit the applications of the project in terms of volume and visibility of the vapor produced. Data recorded from testing is presented in Figure 4.
- The containment fixture constructed fit the particular constraints of the design while being able to contain the vapor without issue.
- Testing verified that modified computer fans can easily and efficiently vent the containment fixture of fog vapor.



Significant Findings

- A liquid solution can be superheated and instantly vaporized by applying a large amount of current through a heating coil that surrounds the liquid.
- Fog solution has the potential to stain and leave a film. Fog juice ended up being our choice and a cleaning apparatus would counter the residue.
- A common source reservoir was able to supply multiple vapor producing atomizers, maximizing the fog production rate.
- Microcontroller technology was utilized to integrate the various electronic components into a cohesive and automated system.
- The epoxy used to bond the acrylic containment fixture was unaffected by the potential corrosive effect of the fog-filled environment.
- The entire system is designed to sit within an independent module that, with minimal modifications, can attach to any existing pinball machine.

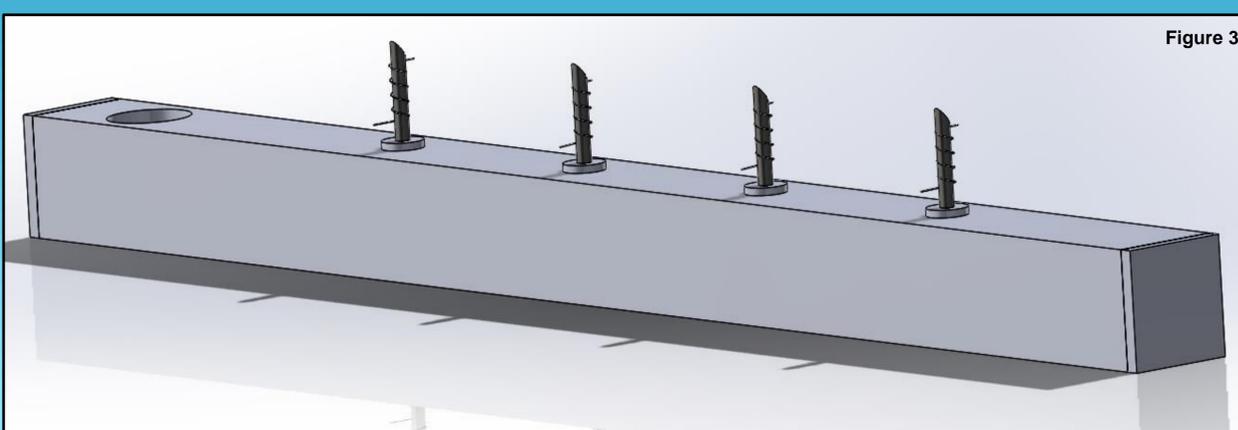


Figure 3

Comparison of Fog-production Devices

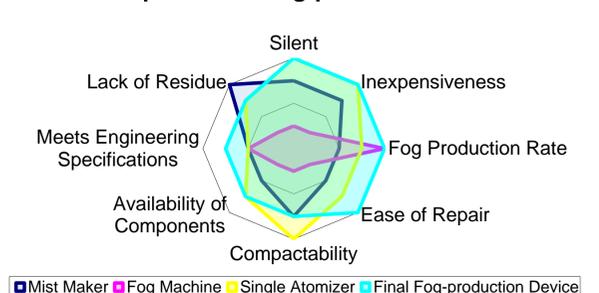


Figure 5