Marcus Gurule
Team First Report
Flow Visualization

Team 8: Danny Baker, Brett Sibel, Marcus Gurule, Theo Petrides

Viscous fake blood flow and dry ice give the carved pumpkin a 'spooky' feel

Introduction:

Our initial idea began with creating something involving fire. We had originally set out to do something involving boric acid or creating colorful flames using these flame packets which have a variety of different sulfates in them that produce different colors when ignited. However, we decided to go a different route given the circumstance that it would have been to dangerous at the time of the photography. We weren't well equipped to plan out something involving flames.

In the spirit of Halloween, we decided to do something simple. It involved using a fake blood which was carefully put onto the pointed teeth of a carved pumpkin. The overall viscosity of the blood would extend long enough to take an image that would provide a "spooky" feel, but also demonstrate basic fluid flow. Furthermore, we used dry ice purchased from a local King Soopers for an additional fluid flow effect to our setup.

Procedure:

The procedure was rather simple. The list below shows the items required to give us our final photos for each team member.

- Camera Equipment: DSLR/tripod
- Pumpkin and various cutting utensils for carving
- Fake blood and dry ice used for flow visualization
- Gloves to handle dry ice and Q-tips to apply fake blood
- Flashing LED lights and scented candle to light up inside pumpkin
- Various house lighting fixtures for proper uplighting up pumpkin
- Newspapers to avoid mess

The overall process was fairly simple overall. First, the pumpkin had to be carved out. We searched online for different stencils until we had found one that seemed ideal.
Later, we placed newspapers on the kitchen table and began carving the stencil and removed all the seeds and other unnecessary pumpkin guts. We had particularly liked the teeth on our pumpkin and thought it would be a great idea to apply the fake blood to the teeth and capture images as it fell slowly.

Once all the carving was done, we placed water at the base inside the pumpkin and carefully placed a candle inside which was then later lit to illuminate the pumpkin from the inside. The water provided a area to allow the dry ice to sublimate. We had originally tried colorful flashing LED which would make the sublimation of the dry ice look a lot better, but we were satisfied with those photos, and instead decided to use the continuous lighting of the candle.

Once we placed our candle inside the pumpkin we lit it carefully ensuring we didn't burn any of the surrounding areas inside the pumpkin. We felt it would be better to have the carved out lid of the pumpkin remain away from the lit candle as it could have caused unnecessary smoke in the house, and surprisingly provided a better overall camera shoot.

The dry ice was carefully put into the front of the pumpkin where it's mouth was and the dry ice sublimated quickly in the base where there was water. This provided a 'oozing effect from the mouth was. Next, we applied the fake blood with the Q-tip to each of the teeth. We had multiple trials to ensure we would get different yet unique photos for each of our team members. The Q-tips allowed us to uniquely paint each tooth of the carved pumpkin and gave us enough time to allow the viscous flow to creating hanging drop.

Unedited Image:

Edited Image:

Camera Settings and post processing:
Device: Canon EOS Rebel T5
ISO: 3200
Shot: 1/60 sec. f/5.6 55mm
Test subject distance: $1\frac{1}{2}$ □□

Post Processing:
The intent of the edit was to bring out more of the orange color in the photo as well as bumping up the red colors in the blood.

Viscosity Equations:
The Fake Blood which is mostly a mixture of (insert ingredients here), is formed from a slender drop approximation and can be equated by the following equation and diagram below:

$$A(x,t) = 2\int f(x,z,t)dz$$

FIG 2: As referred to as the slender drop area approximation which determines the area of the droplet as a function of the integration from the derivation of specific boundary conditions of the Navier-Stokes Equation.

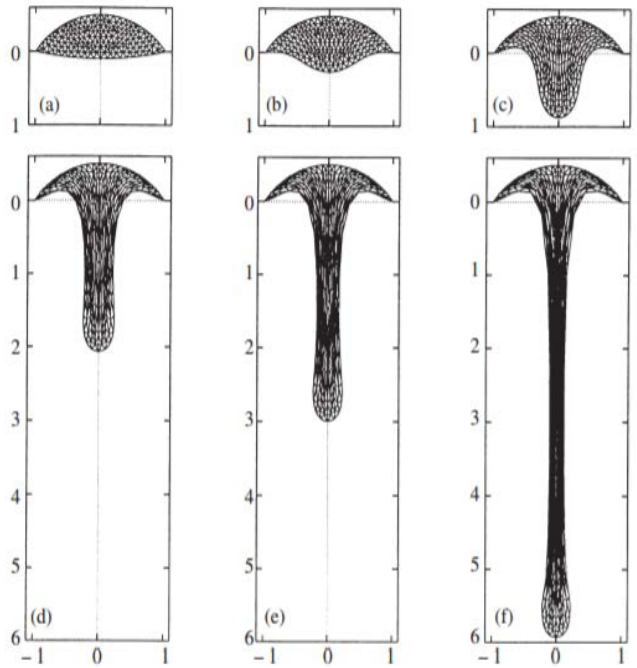

FIG 3: Shows the droplet as the time increases so does the length and furthermore the area.

The longer the time spent dropping due to gravity the longer the fluid drop will be in this equation it ignores the breaking of the fingering of the fluid droplet because as time goes to infinity the length of the droplet increases. However, under this circumstance the we can ignore the fact that it won't break, in case of the pumpkin we only care about the axisymmetric occurrence that is happening with the fake blood flow.

Conclusion:

The overall image, portrays something that the team had really enjoyed. It focused on the viscous blood flow of the pumpkin which gave it a more overall spooky effect in the spirit of Halloween. Furthermore, the dry ice added kept the candle and other various background elements from being distracting, lastly, the candle added a warm feel to the photo and kept the focus more towards the viscous blood flow.

References:

- Introduction and Procedure written by Theo Petrides
- Ebooks-Gratuits.Me > Balanced Equation Combustion
- Stokes, Y. M. "Extensional Fall of a Very Viscous Fluid Drop." *The Quarterly Journal of Mechanics and Applied Mathematics* 53.4 (2000): 565-82. Web. 1 Nov. 2016.