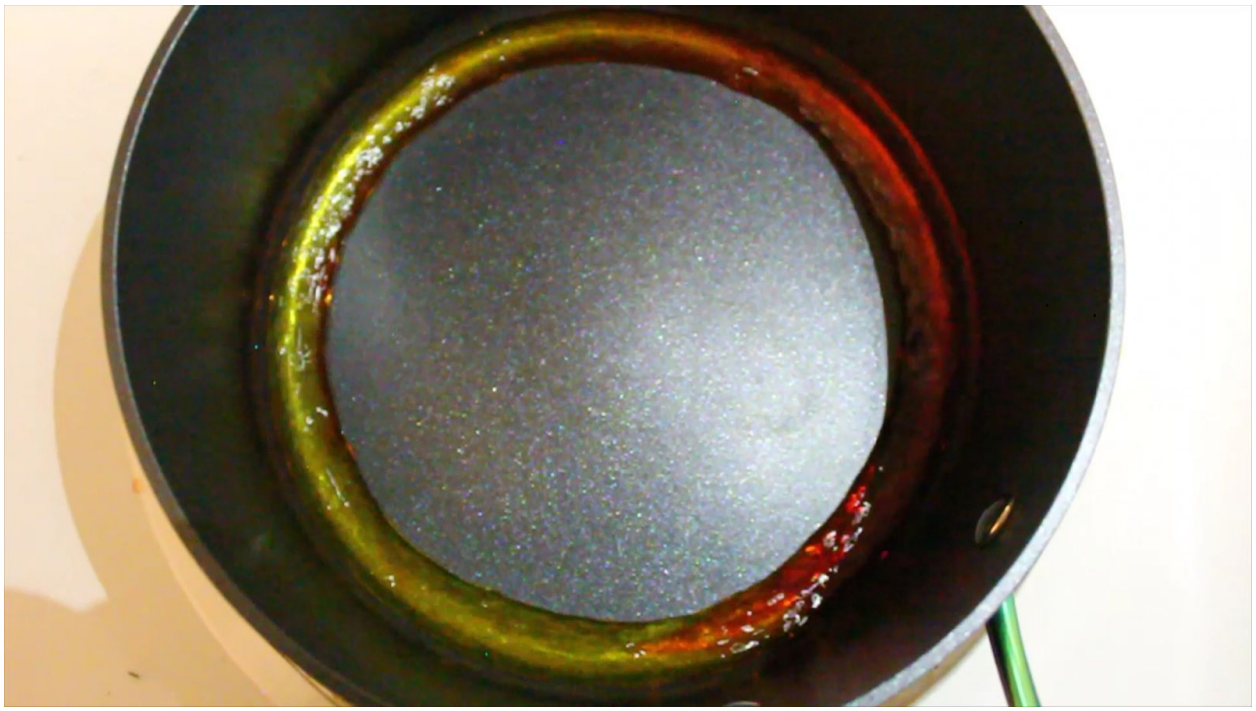
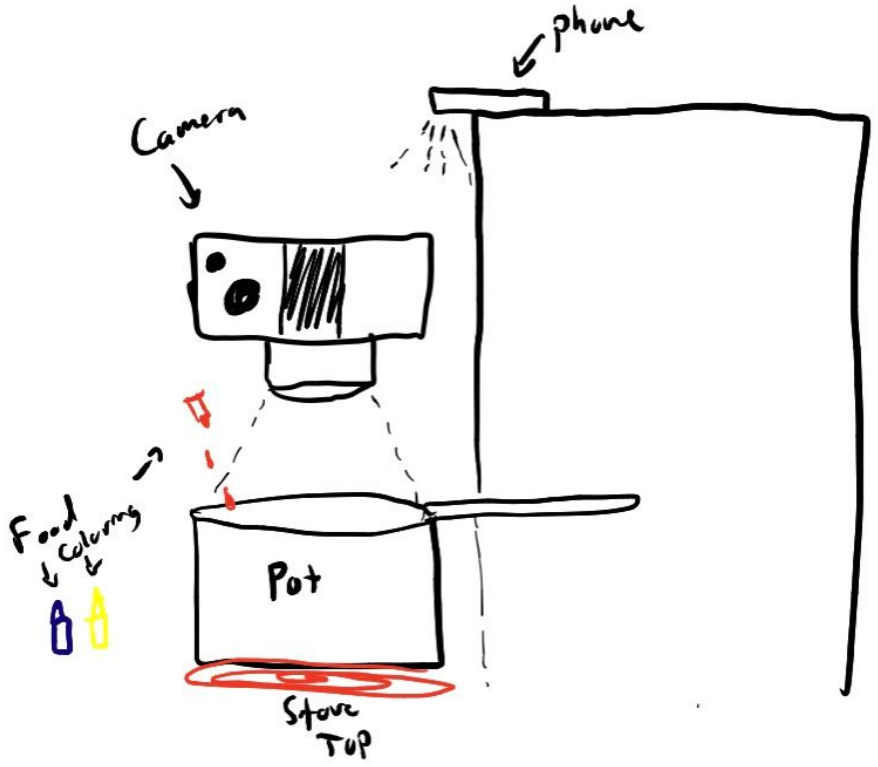


Aldwin Bretoux
Image-Video Assignment 3
MCEN 4151 - 001
11/25/2020
Helped by: Dulce Gonzalez-Beltran

For the third Image-Video assignment, I wanted to take a different approach and try and record a video this time around but I wasn't really sure what kind of fluid flow it was that I wanted to explore. After doing a little bit of research I decided I wanted to study and capture the phenomenon known as the Leidenfrost Effect. At first I was just going to record the water swirling in a circle but decided to add food coloring as it flows to help visualize the phenomenon a little bit better. I would like to thank Dulce Gonzalez-Beltran for helping me capture this flow by dropping the food coloring into the pot. I was able to capture this flow using the following set up.



To create this image, I first set my stove in my apartment to its highest heat and placed a non-stick pot, around 6 in diameter, on top of it and gave it about 20 mins to heat up. I also perched my phone flashlight on top of the fridge, facing downwards into the pan to get better lighting. While waiting for the pot to heat up I had filled up a glass with about 200 mL of water and set aside yellow, red, and blue food coloring to be ready to be dropped in. After the pot had heated up as hot as I could get it, I poured in the water and gave the pan 3-5 swift rotations to get the water movement going and placed it back down on the hot stove. I then hovered the camera over the pot and began recording and as I held the camera steady, Dulce would then squeeze droplets of food coloring, in 5-10 second intervals, directly into the moving fluid starting with yellow, then red, and then blue.

The Leidenfrost Effect is a very interesting phenomenon that occurs in fluids. This effect occurs when a liquid, in this case water, comes into contact with a surface that is much hotter

than that specific liquid's boiling point. Since I was using water and located in Boulder, CO, this boiling point is 94.6 ℃. Once the liquid makes contact with the hot surface the bottom layer of the liquid that had made contact quickly evaporates and creates a layer of steam between the fluid and the hot surface which then suspends the water above, allowing the water to roll around the pan easily. Steam is a poor conductor of heat so not very much heat is added to the water to continue evaporation, which can be modeled with the equation $Q_{dot} = k * \frac{\Delta T}{d} A$. Steam has a k constant of around 44-56 mW/m K, which is pretty small compared to that of water and so the rate of heat transfer between the steam is going to be small. The water moving in a circular motion also has a Reynolds number lower than 2100 since the flow is laminar.

To help visualize the flow we did this in the kitchen with natural lighting from the window being open and the overhead lights being on. I also had light emanating from my phone's flashlight to get more light to see what's going on in the dark pot clearly. The video itself was captured with a Canon EOS Rebel T6 with dimensions of 1280 x 720 pixels and 60 Frames Per Second. I edited this video using a built in video editor on my HP Spectre. I slowed down by 1.3x to make it easier to watch the food coloring be dropped in the fluid and mixed into the rest of the stream.

Overall I fulfilled my intent with this video. I wanted to be able to demonstrate the Leidenfrost effect and make it easier to visualize the flow. To develop this idea further I think I would need to get a tripod with an extension to make it easter to point down into the pot, and so it can be placed farther away to eliminate heat pixels in the video and try and get some better focus.

References

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