The Crawl

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https://youtu.be/oxZS05OlPoA

Team Second
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This video is my result from our second team project this semester. The members of my team that worked directly on this shot with me were Mary Rahjes and Jennifer Kracha. As a group, we wanted to focus on water for this assignment, specifically the interaction between water and a superhydrophobic surface. My original intent was to take a long exposure (time-averaged shot) of colored water falling down the hydrophobic surface at a slant. After many attempts, I was relatively successful in getting that shot, but all of the attempts led me to a much more interesting interaction that I would rather submit for the assignment. The team members would clean up after each shot with a paper towel, and the drops of water would jump to the paper towel. I took it a step further by coming in close for a slow motion video where the paper towel was approaching the water from the side instead of the top.

Apparatus and Science

This scientific apparatus was simple compared to the previous assignments I've done in this class, because including the camera there were only 4 objects. The superhydrophobic surface we used was a white t-shirt sprayed with a superhydrophobic spray, and there was a drop of water with blue food coloring on top of that, as well as a paper towel, and a camera. An illustration of all these objects arranged can be found in figure 1. Only a top down view of the apparatus is provided, because other than everything else being directly on top of the t-shirt, everything is in one single x-y plane in this setup. The camera was centered and focused on the water droplet, and the paper towel was coming in from the left side at about a 90 degree angle.

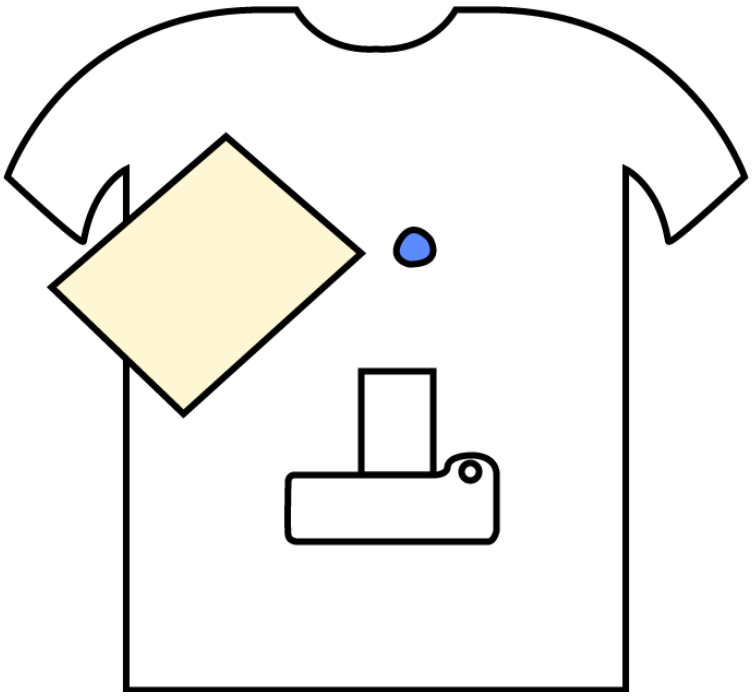

Figure 1: An illustration of a top-down view of the experimental setup. The background is the shirt used for the superhydrophobic surface, the tan rectangle is the paper towel, the blue blob is the water drop, and the camera-shaped object is the camera.

The difference between a hydrophobic coating and a superhydrophobic coating is that a water droplet suspended on a superhydrophobic surface will contact the surface at an angle of 150 degrees or greater, whereas a water droplet will only contact a hydrophobic surface at an angle greater than 120 degrees (Lewarchik 2015). The goal of this report however isn't to determine if the surface we used was actually superhydrophobic or just hydrophobic, but I will mostly be referring to it as "superhydrophobic" in this report, because the spray that we bought and used on the t-shirt was labelled "superhydrophobic."

The purpose of this report is actually to discuss the motion of the water droplet from the superhydrophobic t-shirt to the paper towel. This is because the paper towel is not hydrophobic at all, in fact they are designed to be extra good at absorbing water from your hands. The scientific reason that paper towels absorb a lot of water is because they have lots of small fibers close together, but not quite touching leaving air gaps just ready to be filled by water with an effect known as capillary action (USGS Water Science School). All of this is why as soon as the paper towel is touched to the water droplet, the water pulls itself off of the shirt and onto the paper towel as seen in the video.

Visualization Technique

The first piece of equipment needed to reproduce this flow is a superhydrophobic white t-shirt. This is obtained by spraying a regular white t-shirt with a superhydrophobic spray; the one our team used was “Rust Oleum 278146 NeverWet” intended for outdoor fabrics. When applying the spray to the shirt, I did it outside as well as wore a mask to avoid breathing in any of the nanoparticles that make up the coating. I gave the shirt 5 coats of the spray, letting it “dry” in between each coat, and with the last coat, I also gave another shirt just a single spray to see how they compared. In my video, the 5-coat shirt was used, but other teammates had just as good of a result using the 1-coat shirt. For the drop on the shirt, we mixed about 250 ml of water with 5 drops of blue food coloring, other colors were also used, just not in this particular video. And the paper towel used in this video was a regular paper towel. The video was taken with indoor lighting with large LED lights far ahead. There were no lights used other than the overhead room lighting in the ITLL, and the reflection of all the lights can be seen in the droplet on the shirt.

Photographic Technique

These projects are usually done on my DSLR camera, but this time I used the phone camera on my Google Pixel 2. This is because while my DSLR can record video, it cannot record at high frame rates, whereas the Pixel 2 can record up to 240 frames per second. This video was recorded at 120 frames per second rather than 240, because at the spatial resolution is compromised at a higher frame rate, and staying at 120 allowed me to keep the 1920x1080 pixel resolution of the video. To then slow down the video so it looks like it was recorded at 240 frames per second, it is played back at just 15 frames per second. This works really well for visual effect, and definitely works, but it is not in fact increasing the temporal resolution up to 240 frames per second, just merely making it appear that way. The drop was a small drop, just about 5 mm wide, making field of view about 50-60 mm. The camera was about 80-100 mm away from the drop of water. Because it was a video taken with a phone, I didn’t have control over any of the exposure settings, it was all done automatically, and I can’t go back in to look at them later. But I do know that the focal length and aperture on this phone are both consistent, and doesn’t change with the video at all, so the fixed aperture of the lens is f/1.8, and the focal length is 4.459mm. There was no color or exposure work done in post processing at all, but the

video was slowed down 50%, as mentioned earlier with the 15 frames per second playback rate, music, and title and end cards were added were added in post.

Conclusions

I chose the music for maximum drama, and the main reason I even slowed down the video in the first place was to time it with the music better. In the end, I think the music turned out awesome on this project, and because of the timing, it actually adds a lot to the project, making it better than it was before. I am slightly disappointed that I didn't follow through with submitting my original idea for this project, but at the same time, I'm so much happier with this end product than I ever expected to be with this project. Once again, that's probably thanks to the music. I think to improve on the project I could have used a white paper towel instead of an ugly tan one to make the visuals even cleaner, but I feel like they are also pretty good already.

References

Lewarchik, Ron. (2015). *Hydrophobic Coatings Explained*. Prospector Knowledge Center. [Web] https://knowledge.ulprospector.com/2530/pc-hydrophobic-coatings/

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