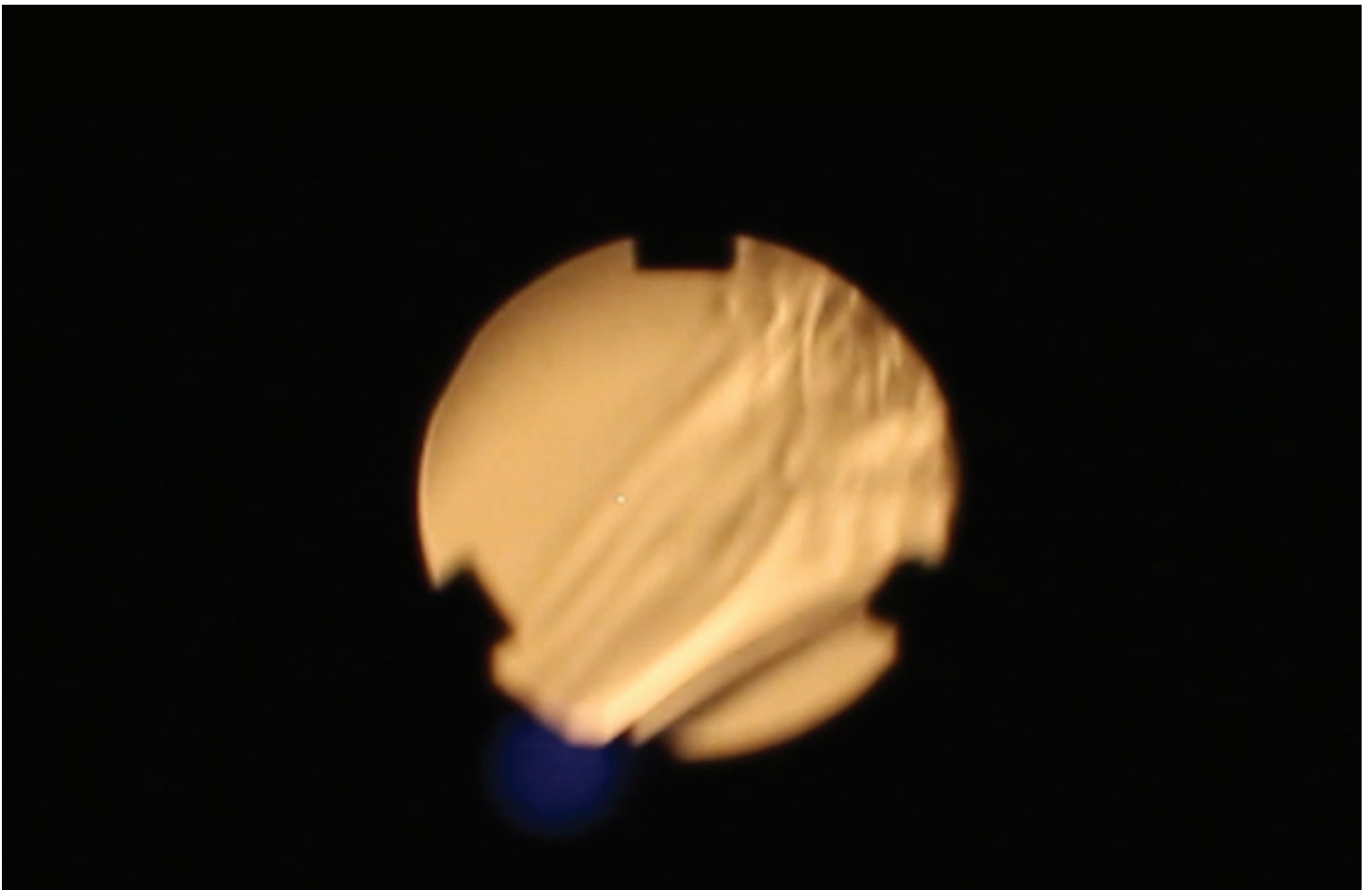


Torch Flow: Report

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BACKGROUND

This video was taken on December 18th, 2022, with help from team member Lucas Fesmire. The video was created using schlieren imaging to visualize the heat and airflow from a small propane blowtorch. The schlieren imaging setup was extremely difficult to set up. The mirror had to be aligned with uncanny precision, every single light source, from windows to microwave clocks, had to be covered and we needed more than 10 ft of space to run the experiment. In the end we were able to produce a short video that I am extremely proud of. It's awesome to see our hard work pay off, and the novelty of what we produced only made it better.

SETUP

This image was taken in my dining room after a lot of setup. Schlieren Photography requires an extremely controlled environment in order to work well, so a lot of the setup work went into making my living room suitable for the experiment. The first thing we did was make sure we had a level surface that was long enough. We had my dining table which was exactly 6ft and another table about the same height. Luckily we had a tripod for the camera which made it a lot easier to get it in the right position and hold it still.

We tried the experiment on the flat table for a while but quickly realized there was too much light to get a clear image. We proceed to block out every possible light source. We surrounded the LED with a cardboard box and punched a small hole in it. We proceeded to put flags and tarps over the windows and turned off almost every light in the house, and finally we had to tape off the lights on the stove and microwave as they were till causing too much light.

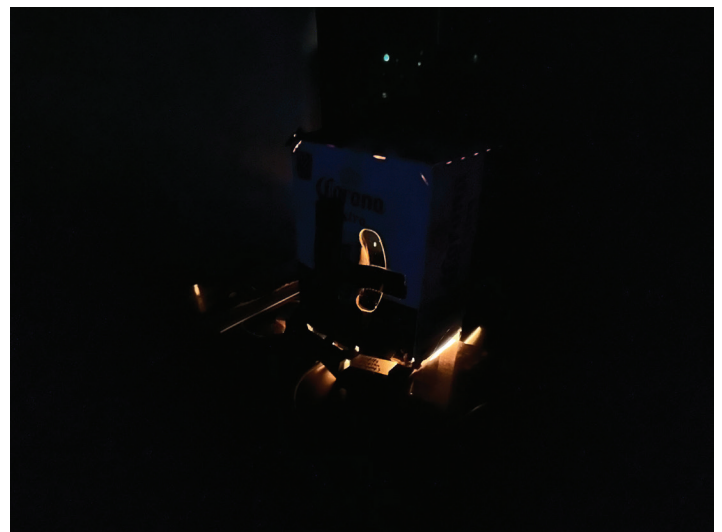
The final setup consisted of the light emitting box on one side of the table with the mirror and subject 6ft away on the other side. The razor was then placed just next to the lightsource and the camera was placed about 2 inches behind it. The mirror was carefully tuned to reflect the light directly back at the razor and camera. We initially thought we might use two mirrors but eventually decided a second mirror would add too many variables.

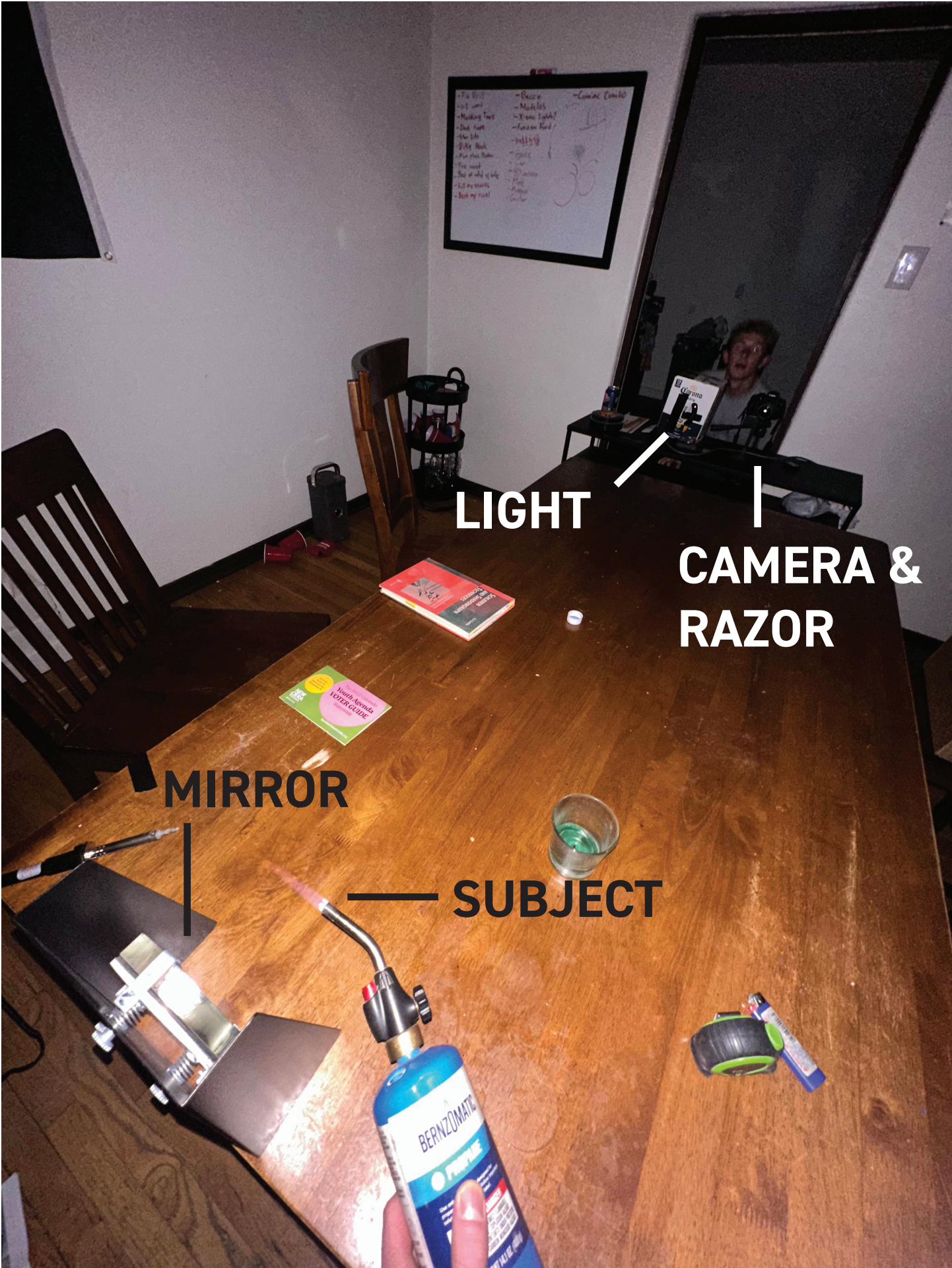
SETUP IMAGES

Light and razor (lights on)



Light and razor (lights off)





LIGHT

CAMERA &
RAZOR

MIRROR

SUBJECT

PHYSICS

I really like schlieren photography as it makes it so easy to visualize physics phenomena that you would normally never get to observe. In the case of this video it allows us to easily visualize the hot air and fluid flows coming off of a blowtorch. The biggest thing that surprised me after actually seeing the video was how little the hot air rises when the blowtorch is set high. I would have expected more air to rise from the flame as it burns hotter, however in the video you can clearly see that as the intensity of the blowtorch is increased, the hot air takes more and more distance to rise. This is likely because higher temperatures also mean a higher velocity of fluid is coming from the blowtorch, which is able to travel much farther before rising.

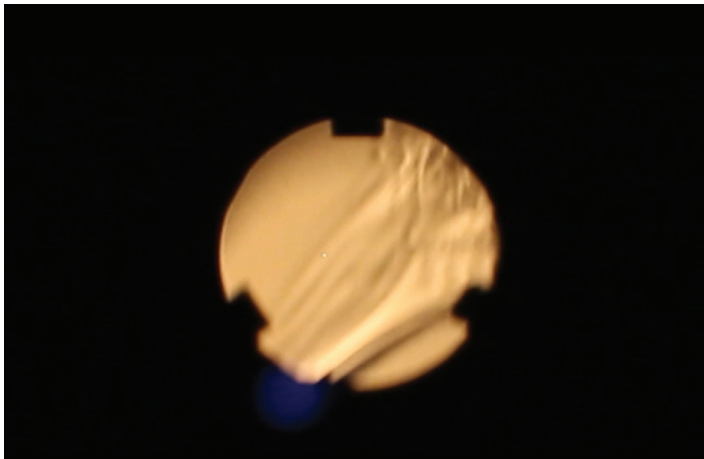
VISUALIZATION TECHNIQUE

This visualization used schlieren imaging which uses mirrors and a razor blade to visualize fluid flows. The mirror reflects light that has passed through the moving fluid. This reflected light then passes over a razor which blocks out half of the scattered light, leaving only light that had scattered in one direction. By focusing this light back in on a sensor we are able to get a great image of the fluid that shows us things we could never see otherwise.

PHOTOGRAPHIC TECHNIQUE

The image was taken with a Canon EOS Rebel T5. The original video was 1920 x 1088 and was shot at 30 frames per second. The only edits performed on the video were a crop to remove the unnecessary black space, and the addition of music and a title card.

Edited



Unedited



REFLECTION

This visualization was unforgettable both because of its difficulty and its novelty. Schlieren imaging is extremely surreal. At one point we put our naked eye behind the razor, about where the camera should have been, and we were able to clearly see the heat waves from a candle without naked eye, something we had no idea was possible. Once we got the camera set up it only got better, and we were able to take some of the coolest photos and videos I think I'll ever have the opportunity to take. I'm extremely happy I decided to try Schlieren imaging, and it was definitely worth the challenge.