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MCEN 5151

Team Second

11/10/2019

For my team second image, my team and I decided to try and capture water droplets. Specifically, we wanted to try to recreate some neat droplet pictures that we had been show in class. Having seen some products from past years in class, we set out to try and capture the same type of image. Originally, the group was going to try and use the high speed camera available for checkout in the ITLL however, Sophie Adams, one of the group members who collaborated with me on this picture, had a camera with high speed functions so we decided to use this instead. The other students who helped with this picture were Kensue Kiatoukaysy and Kailey Shara.

The liquid used was just ordinary water with yellow dye in it however, the droplets were being dropped about a foot above the wine glass. An important part of the picture is approximating how fast the droplets were when they came into contact with the water. To do this, the mass of the water must first be approximated. Though the intermolecular forces of the water molecules, such as adhesive forces, surface tension, and hydrogen bonding, and gravity cause the droplet to take on an oblong, organic shape, the air resistance could in theory have a greater or lesser effect on the water's free fall[1]. Since air resistance will have such a minor impact on the speed of the water for this particular experiment, it will be neglected. To find the speed of the water, the following two equations are needed:

$$s = 0.5 * g * t^2$$

$$v = v_0 + g * t$$

In the equations above, *s,* represents the distance traveled, which in this case is 1 foot, *g* represents the gravitational constant of approximately 32.0174 ft/s^2, *t* represents the time it takes for the water to drop, v_0 represents the initial velocity of the object, which in this case is 0 ft/sec since the water was not moving initially and at rest, and finally, *v* represents the final velocity[2]. Once these equations were solved, it was found that the drops of water would take approximately 0.2493 seconds to reach the water in the wine glass, and the speed at impact was about 8.022 ft/sec. It is important to note that the mass of the water is not needed since the only force acting on the particle in this experiment is gravity.

The source of the fluid was taken from a nearby sink. The water has been died yellow using yellow 5, which is also called tartrazine and has the following chemical formula: $C_{16}H_9N_4Na_3O_9S_2$[3]. The exact amount of dye used was not measured, as very little was needed. The wine glass was a standard wine glass and an ordinary dropper was used to drop the water into the glass. As mentioned previously, the water was dropped from the dropper approximately 1 foot above the wine glass. The lighting source used was a 50-watt tungsten

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[1] F.K.Hansen; G. Rodsrun (1991). "Surface tension by pendant drop. A fast standard instrument using computer image analysis". Colloid and Interface Science. 141 (1): 1–12.

[2] "1-D Kinematics: Describing the Motion of Objects." The Physics Classroom, www.physicsclassroom.com/class/1DKin/Lesson-6/Kinematic-Equations-and-Free-Fall.

[3] National Center for Biotechnology Information. PubChem Database. Tartrazine, CID=164825, https://pubchem.ncbi.nlm.nih.gov/compound/Tartrazine

light. The picture was taken straight on from the front. For a diagram of the set-up, see Figure 1.

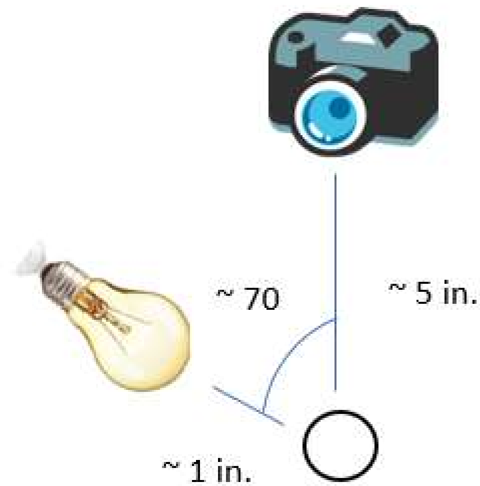

Figure 1: Top down view of the setup

This picture was captured on a Nikon D7200. The dimensions of the original, unedited picture as 6000 x 4000 pixels. The shutter speed was 1/2500 sec, which was chosen in order to negate motion blurring. The f number was with a focal length of 70 mm. The ISO setting was 6400. The picture was taken about 5 inches from the actual wine glass. The field of view of the original picture, seen below in Figure 2, is about 5 inches by 4 inches in height. The biggest difference between the edited picture and the original, besides some small contrast which was set using the curve seen in Figure 3, is the blacking out of the paper towel that was in the bottom right of the image. The paper towel was an incredibly distracting element in the picture and was important to delete from the image. The contrast curve shows that I decided to some of the lighter pixels darker. By doing this, the outline of the droplet and detail of the liquid became more pronounced. I do not feel that this detracted from the image or caused any detail to become lost and instead accentuated it.

Figure 2: Original, unedited picture

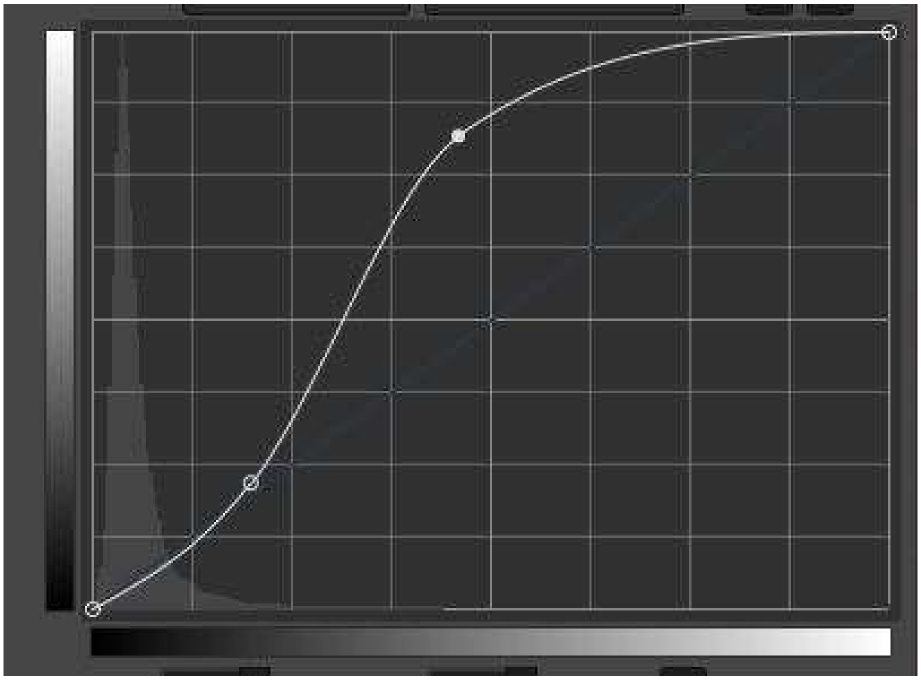

Figure 3: New contrast curve set (white line) compared to the original (blue line)

I am extremely pleased with how the final version of the image turned out. From the beginning of the class, I had always wanted to try to capture a water droplet and I feel that I have successfully done so. By experimenting with the height the water dropped at, I believe the final height chosen was perfect for the effect it had on the water in the wine glass. The only aspect that I am not please with is the slight, still dark droplet. During the critique of my image during class, many people did not find the image to be too dark. I however believe it is slightly dark but I am also happy with how it is as well, which is the reason I did not go and try to edit it further after the critique. It was also fun being able to visit some equations from physics in the free fall equation that I have not had to practice using in a number of years. I am most pleased with how in focus the picture is, as this was one of the hardest parts of taking this picture. I was most worried about a motion blur however, I picked the right settings to negate any of this occurring. If I was to pursue this idea further, I would maybe take a slow-motion video of the entire incident, enabling us to see the physics of ripples caused by the droplet to be observed.