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Image-Video Report 2
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Image-Video 2 Report: Watercolor Paint on a Mirror

This image is taken of watercolor paints on a concave mirror. Water was highly saturated with pigment, then dripped into a collective pool, to create an image displaying the motion and depth of the fluid. A light was shone very closely on the mirror to create some backlighting that would illuminate the pigments, and display the layers of colors.

When the droplets of pigment splashed into the water, the diffusion of the paint and the boundary layers between colors created a color portrait that appeared to be dynamic, but was actually relatively static. I wanted to capture this phenomena in my image, and display the beautiful contours and depths that were visible.

Some of the apparatus that were used in order to create the picture were a hinged mirror, paint brushes, a reading lamp, and watercolor paints. The mirror was concave, meaning that it could hold a pool of the colored water in a very stable manner, and also had its own base, so it was able to stand on its own. See Figure 1 for a visual representation.

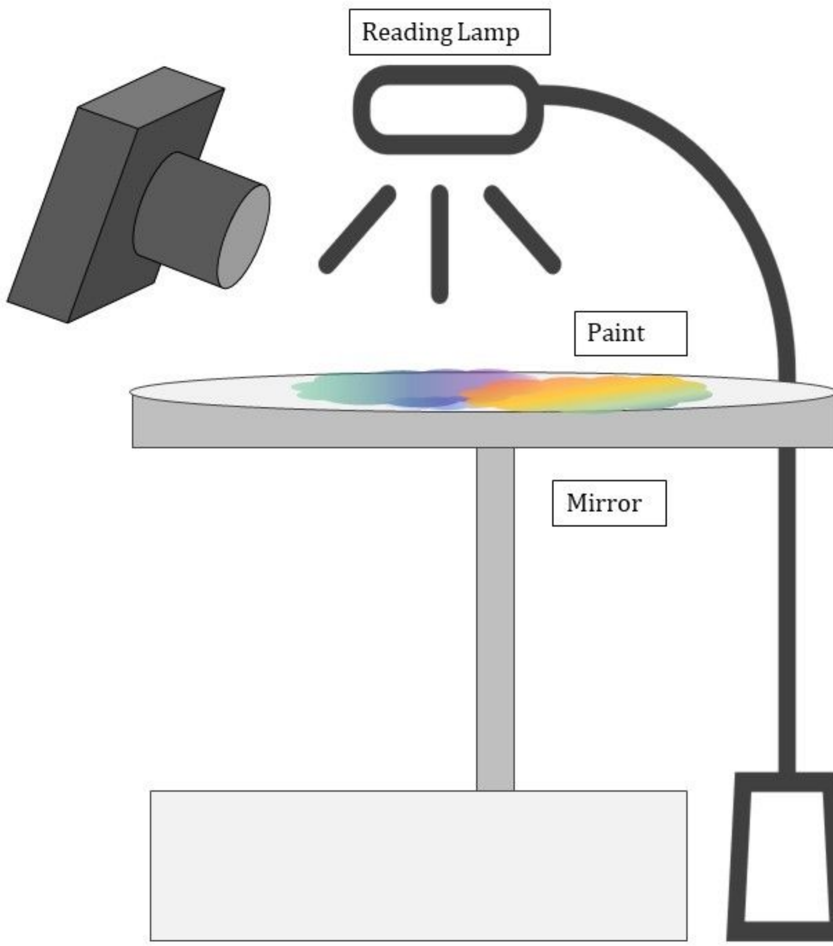

Figure 1: A sketch of the image set up, including the camera, paint, light, and mirror

Some of the flow phenomena that characterize this image are plumes, droplets, negative buoyancy, and suspended particles. In particular, the flow could be described by an instantaneous point source of particles, since I was dripping in droplets of water that were heavily saturated with suspended pigments. However, this depended on how much the droplets splattered when introduced into the pool. This splattering phenomena can be described by the Weber number, which describes the relationship between “droplet impact velocity and radius to surface tension,” (Baron). The Weber number is a ratio of the aerodynamic force that “causes the drops to deform and ultimately disperse,” and the cohesion force that “opposes the increase in surface area which is caused by the deformation,” (“Weber number”). This equation is as follows:

The Weber Number:

$$We = \frac{\rho D {V_h}^2}{\sigma}$$

Where ρ is the density of the fluid, D is the diameter of the droplet, V_h is the impact velocity, and σ is the surface tension. In this case, I calculated the velocity of the droplet per kinematic equations and an estimated falling time. In this case, air resistance was assumed to be significant. The droplet of water was estimated to have a diameter of 1 mm, the volume of a sphere, and the density of the liquid to be that of water. Drag coefficient was estimated to be 0.5 for a raindrop, but was assumed to be negligent in this case for simplicity. The surface temperature of water at room temperature was estimated to be 72.8 dynes/cm, or 72.8 g/s^2 (Nave).

Neglecting Drag:

$$\Sigma F = F_{gravity} + F_{drag}$$
$$\Sigma F = ma + 0$$

Calculating Final Velocity:

$$V = V_0 + a * t$$
$$V = 0 + 9.8\ m/s^2 * 0.38\ s$$
$$V = 3.724\ m/s$$

Calculating the Weber Number:

$$We = \frac{997\ kg/m^3 * 1*10^{-3}\ m * (3.724\ m/s)^2}{0.0728\ kg/s^2}$$
$$We = \frac{997\ kg/m^3 * 1*10^{-3}\ m * (3.724\ m/s)^2}{0.0728\ kg/s^2}$$
$$We = 189.93$$

This is a relatively high Weber number, meaning that the effects of surface tension may be neglected in this case. This has a factor of error due to the assumptions made.

Next, I also explored the photography side of this flow visualization. The visualization technique I used to capture this photo were watercolor paints, and a very close light source to produce the depth of the color, and the backlighting from the mirror. The light that was used was an adjustable LED reading lamp, with white LEDs.

This picture was captured on a Canon Rebel XT. The aperture used was f/5.6 for a moderate level of light let in, and a moderate depth of field. In this case, the depth of field was less relevant since the subject was very flat. The shutter speed was set to 1/25 for a relatively long exposure. This was used to capture a relatively static image. The ISO was at 100, since there was a great deal of light available for the camera. The camera was set up less than a foot away from the liquid, with a focal length of 55mm, so that I could zoom very close to the details. This means that the field of view is less than a half foot. The image was taken at 3516x2328, and was cropped. The colors of the picture were also edited in order to increase the saturation, and improve the depth to the image. The dark portions of the picture were also set to a black, in order to frame the composition and create more contrast.

Original

Edit

To me, this image reveals the beautiful diffusion of particles in water. I chose it because of the interesting layering in the center of the image, where because of the flow, there appears to be a “bridge” of color in the middle passing over another layer. I also think the combination of colors is very beautiful, and was an easy way to get a wide ranging palette. Something I wish I could have done differently is having such a bright white portion in the bottom right of the original image. Because of this, I was forced to crop the image, and removed some of the beautiful parts that I enjoyed, such as the interaction of the red, yellow, and green in the bottom left, and the rainbow flow in the bottom middle/right.

Something I want to improve with the image is the color editing. I liked the increase in saturation that I made, since I think it improved some of the colors. However, I think it also made the image darker, and some of the contrast is lost. I also made the right middle part of the image look more brown, rather than orange, which I didn’t particularly like, but also didn’t hate. Overall, I was happy with the editing I did, but in the future I want to improve my skill set.

I am a very amateur photographer, so I was happy with the final result of my image, and feel that I fulfilled the intent of the image. I think that this fluid phenomenon could be further explored by using different surfaces underneath the pigment, such as a slanted surface, in order to get more motion. I played around with tilting the mirror, but was not pleased with any of the results. However, I think with more patience, a very interesting image could be achieved.

References

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