



Project 3

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Introduction

For this project, I decided to create some light flame around some object, with the light flame color object could be seen and image could be captured with both flame and object shown. The motion of the flame is hard to capture well, in order to get a nice picture the shutter speed has to be sufficiently high. However, with the high shutter speed the flame became less visible. The picture above was taken home with some motion blur, it's hard to set up camera focus and resolution perfectly.

Procedure

Table 1 showed the materials used for this experiment

Table 1. Materials

1	Hand Sanitizer
2	90 % Rubbing alcohol
3	Pine Cone
4	Plate
5	Aluminum foil

The original idea was to create a light color flame around pine cone, so I put hand sanitizer evenly on the surface of the pine cone. Hand sanitizer contains alcohol which evaporates really fast and it was hard to get it on the pine cone surface without evaporating. So I took a different path, putting pine cone on the aluminum foil wrapped flat. Pouring rubbing alcohol on the pine cone, and light it up. Once the flame was created, then I put hand sanitizer onto the object. We needed to pay extra attention when putting hand sanitizer onto the flame, because hand sanitizer will generate a huge flame, therefore heat resistant glove is suggested when doing this experiment.

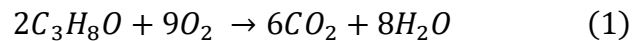
The most challenge part about taking this image was getting a decent focus and exposure on the flame. As I mentioned above, high shutter speed will give a nice flame but high shutter speed means more light needed. The total amount of available light from the flame was not enough for high shutter speed in this circumstance. After tried multiple times, the finalized data for camera is shown in Table 2. For the post-processing, the image was edited using Photoshop, Curve and contact were changed. The original and edited image were shown in Figure 1&2.

Table2. Camera Data

Camera	Canon EOS REBEL T2i
Focal Length	33 mm
Exposure	1/160s, f/5.6, ISO 3200
Image Size	2304 x 3456
Resolution	72 Pixel/ Inch

Discussion

Rubbing alcohol is composed of isopropyl alcohol and water, for this experiment the 90% isopropyl alcohol was used. In order for combustion process to happen, three things are required, fuel, air and heat. In our experiment, alcohol was acting as fuel and lighted match was used to start the combustion process. The following formula shows the chemical reaction:



Understanding Combustion process is important to understand the behavior of flame. From the original picture, it shown that there were two different visible colors of the flame, blue and orange. The different color is a result of many factors, which include amount of oxygen supply, air convection and blackbody radiation. When alcohol started burning, it created carbon dioxide and heated the surrounding air. The heated gas will rise and spread out, this causes the irregular shape of the flame. The amount of oxygen used during the combustion process changes the color of flame as well. When there is less amount of oxygen, it creates yellow or orange color of a flame due to the incomplete combustion process. When the combustion is 100%, the blue flame occurs.

Blue flame may also occurs due to the other factors, hand sanitizer was used during this experiment and hand sanitizer contains ethyl alcohol which may provide different color of the flame. Also from the picture, blue flame appeared at the bottom of the picture which more close to the pine cone, and burned pine cone may be considered as additional heat source. This may also affect the flame color.

Final Thoughts

I'm happy about my picture, the blue flame wasn't that visible in the original picture but after Photoshop it was shown clearly. The pine cone wasn't showing completely in the picture, I might need to work on that part bit more.



Figure 1: Original



Figure 2: Edited

Reference:

- [1]. http://www.auburn.edu/academic/forestry_wildlife/fire/combustion.htm
- [2]. <https://www.grc.nasa.gov/www/k-12/airplane/combst1.html>