Create Pointillism Art from Digital Images
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**Step 1: Preprocessing**
- Apply low-pass filtering
- Down sample image
- Blur for artistic effect

**Step 2: Determine Color Palette**
- Use K-means to find primary colors
- Convert RGB to HSV
- Brighten up and saturate colors
- Add complement colors

**Step 3: Generate Pointillism Art**
Every pixel in the preprocessed image is converted into a dot cluster composed of only 3 colors from the color palette and then all these dot clusters are scattered across a blank canvas to form the resulting image.

**Color Transformation**
\[
\begin{align*}
Q_1 &= C_1(G) \cdot P(G) \\
Q_2 &= C_1(B) \cdot P(B) \\
Q_3 &= C_1(R) \cdot P(R)
\end{align*}
\]

The 3 primary colors are chosen by finding two primary colors that have the smallest distance to the pixel color and adding a random third color from the palette. \(Q_1, Q_2, Q_3\) are the concentrations of three primary color components.

**Determine Number of Color Dots**
The number of dots of each primary color in a cluster is \(n_1, n_2, n_3\), respectively. Intensity determines the sum of \(n_1, n_2, n_3\), and the maximum sum is designated to be \(\alpha\).

**Method to Scatter Dots**
Distribution of dots across the canvas is predominantly influenced by 3 variables, \(\alpha\), \(d\), and \(\sigma\). \(d\) is the distance between the center of each Gaussian dot cluster, \(\sigma\) is the size of the Gaussian distribution, by which dots are scattered individually.

**Brushstroke Orientation**
We also experimented with the orientation of brushstrokes around edges. Image to the left has all brushstrokes oriented to strongest gradient direction. Image to the right has only some brushstrokes oriented to gradient direction stronger than a threshold, and all other brushstrokes are standard orientation.

**Conclusion**
While creating our algorithm for generating pointillism art, we experimented with various aspects of nonphotorealistic rendering, such as color selection, brushstroke shape and size, and dot distribution. Analysis of our algorithm demonstrated that color selection and dot distribution dominate the aesthetic aspects in the creation of pointillism art.