Image Compression

Machine Learning Assignment

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Submitted By:

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Overview

Color Quantization is a technique used in graphics to map (or transform) high resolution images to low resolution images. It is a lossy compression technique, so the image is not restored in its original form after decomposition as we shall see shortly.

This transformation from high resolution to lower resolution is done using **Encoding/Decoding**.

Each color in the original image is represented by a "**representative**", which is stored in the codebook. The index of this "**representative**" is the index of color in the codebook.

The codebook is obtained using **K-means clustering**. The original image is used to construct clusters equal to the required number of colors. For each color the cluster that is most similar to it is determined. All the colors belonging to a particular cluster are represented using the cluster center. The cluster centers represent the entries (colors) in the codebook.

Goals

1. To construct 4 bit, 8 bit and 12 bit codebooks.
2. Using the above codebooks the images were reconstructed.

Original Images

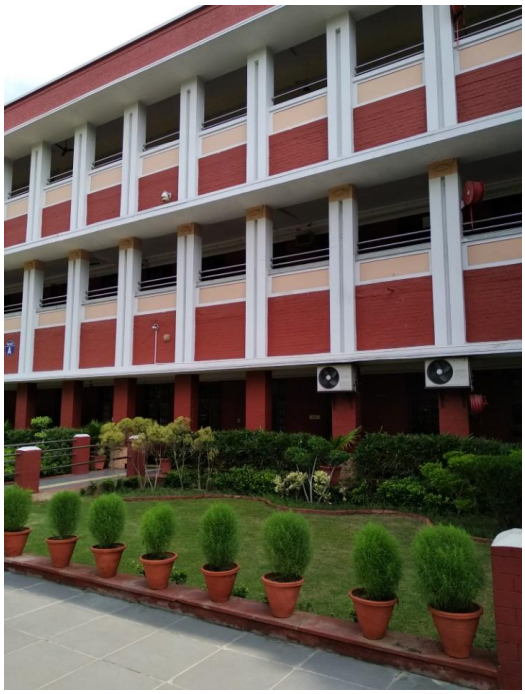


Image1: An outdoor location

- The dimensions of the image are 960 * 720 * 3.
- 3 indicates the RGB color code used in the image.
- We can see the most used colors in the image are red and green.

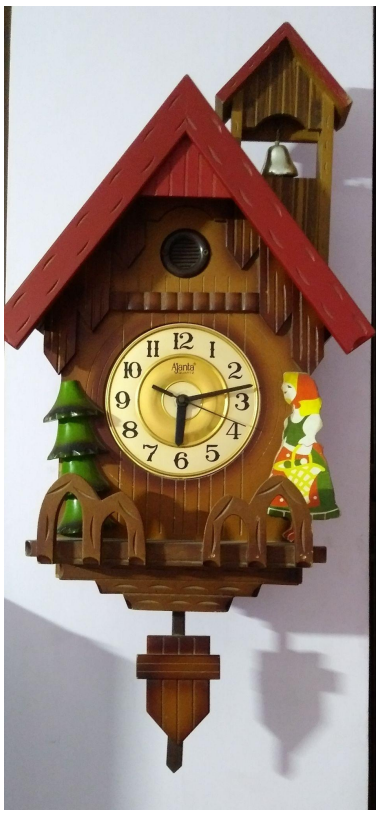
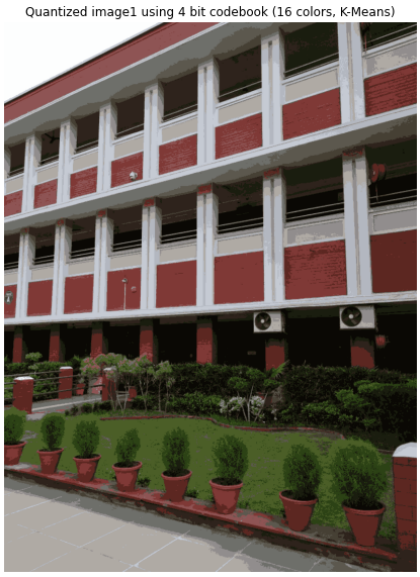


Image2: A clock hanging on the wall

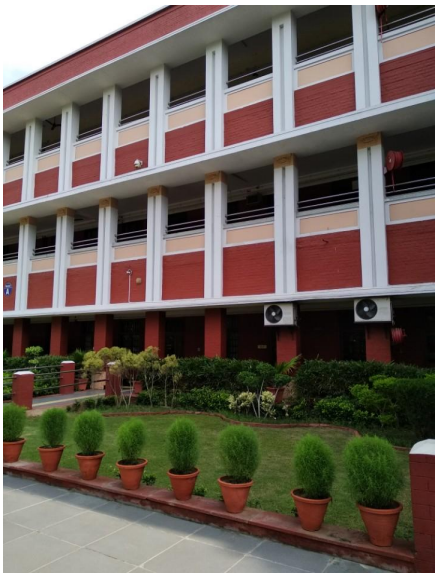
- The dimensions of the image are 3287 * 1521 * 3.
- 3 indicates the RGB color code used in the image.
- We can see the most used colors in the image are shades of brown and yellow.

Reconstructed Image comparison

I. Reconstructing image1 (using 4 bit codebook)



Reconstructed Image



Original Image

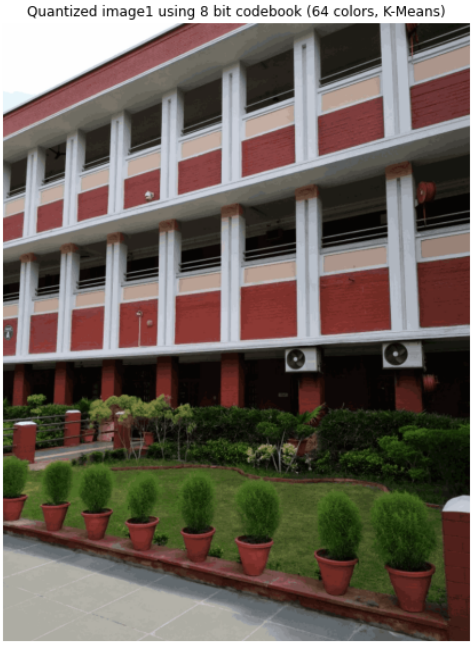
Features of reconstructed image:

- The reconstructed image is of the same size as the original image.
- The reconstructed image uses only 16 colors for the complete image.
- Since the similar colors are represented using the same “representative” color, the shades of the same color are not transformed smoothly.

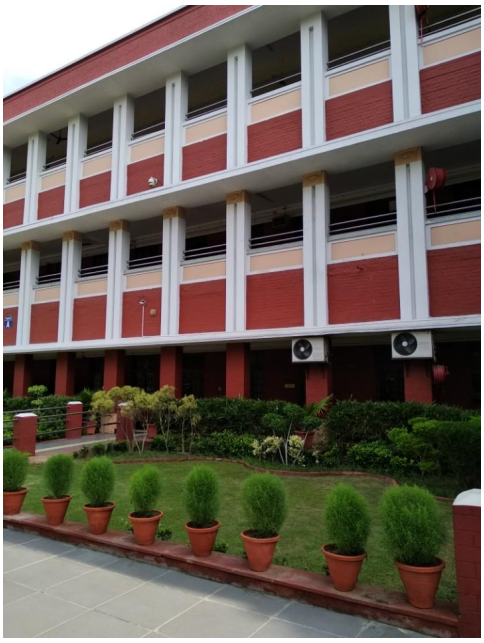
Differences observed:

- The differences can be observed in the right half of the image.
- Also the shadows of the pots in the front yard are also distorted.
- The ceiling of the top floor can’t be reconstructed properly.
- The peach color used on the walls is also different in the reconstructed image.
- We observed that the original image is brighter than the reconstructed image.

II. Reconstructing image1 (using 8 bit codebook)



Reconstructed Image



Original Image

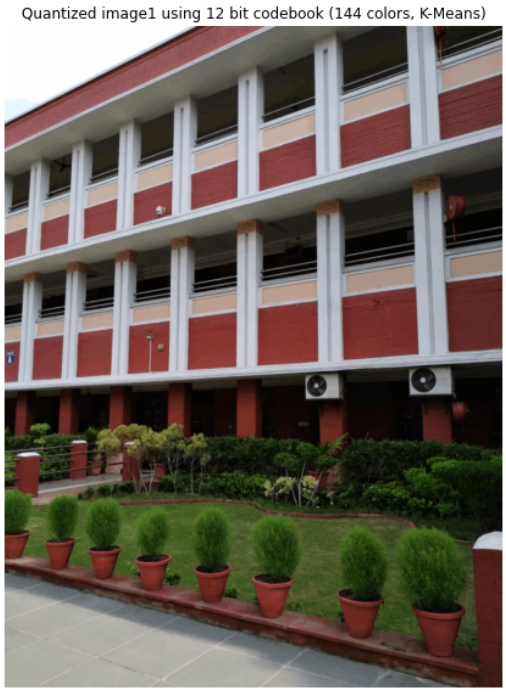
Features of reconstructed image:

- The reconstructed image is of the same size as the original image.
- The reconstructed image uses only 64 colors for the complete image.

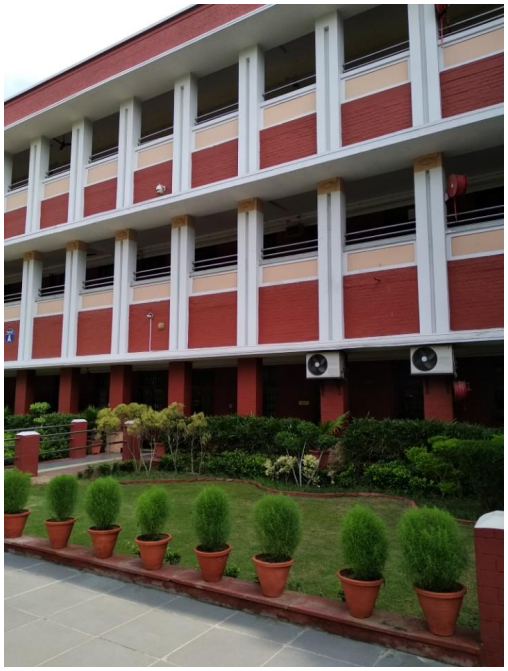
Differences observed:

- This reconstructed image is better than the previously reconstructed image.
- The shadows of the pots in this image are better.
- The ceiling of the top floor is almost reconstructed properly.
- The peach color used on the walls also matches the original one.

III. Reconstructing image1 (using 12 bit codebook)



Reconstructed Image



Original Image

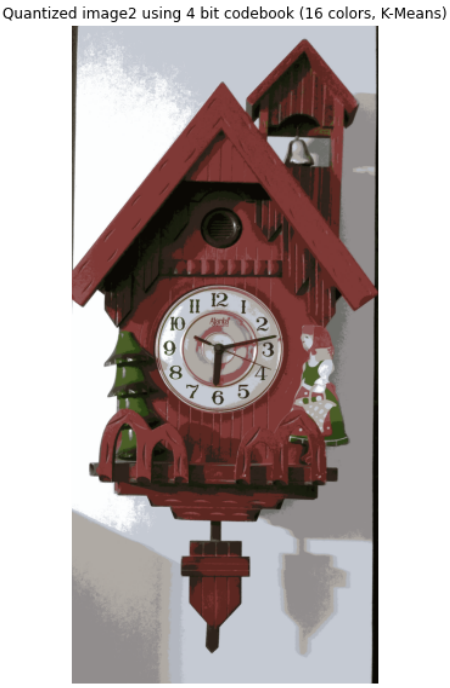
Features of reconstructed image:

- The reconstructed image is of the same size as the original image.
- The reconstructed image uses only 144 colors for the complete image.

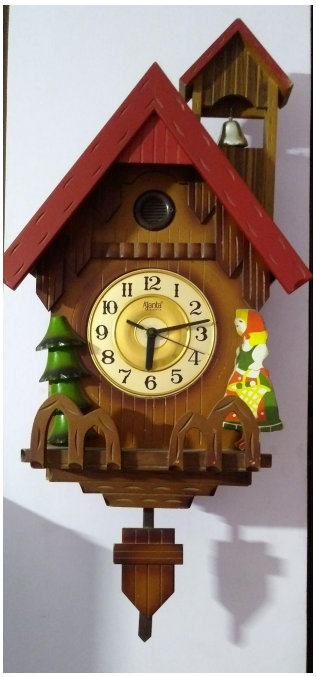
Differences observed:

- This time the original image is reconstructed perfectly.
- The shadows of the pots in this image are perfectly matching the original image.
- The ceiling of the top floor is reconstructed properly.
- Just the bushes near the pillars look blurred in the reconstructed image.
- The reconstructed image looks smoother than the original one.
- It just lacks the sharpness otherwise it's exactly similar to the original.

IV. Reconstructing image2 (using 4 bit codebook)



Reconstructed Image



Original Image

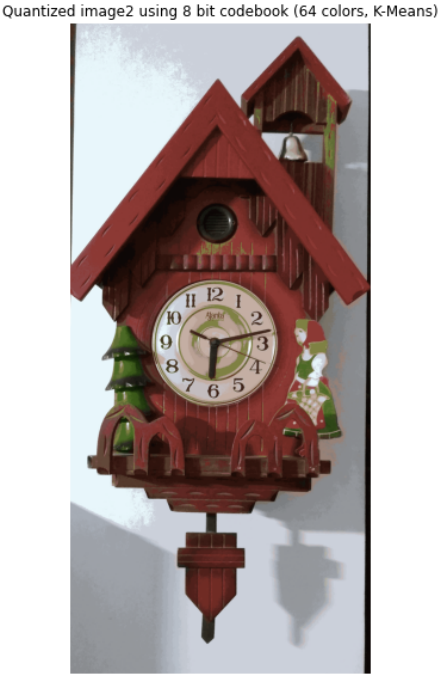
Features of reconstructed image:

- The reconstructed image is of the same size as the original image.
- The reconstructed image uses only 16 colors for the complete image.
- Since the similar colors are represented using the same “representative” color, the shades of the same color are not transformed smoothly.

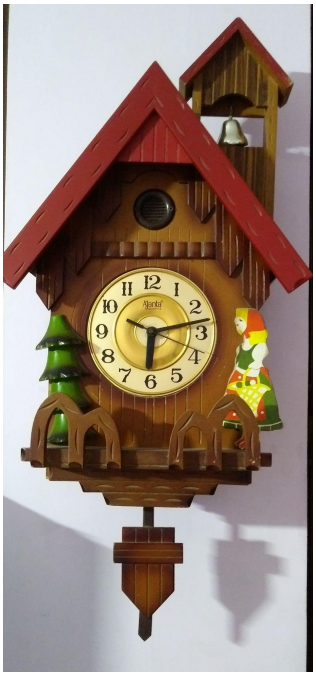
Differences observed:

- The differences can be observed very clearly as the reconstructed image lacks the yellow shade of the original image.
- The upper left corner and the lower left half is also distorted.
- The complete clock is formed using a single color which is not similar to the original one.
- The reconstructed image lacks clarity and sharpness too.

V. Reconstructing image2 (using 8 bit codebook)



Reconstructed Image



Original Image

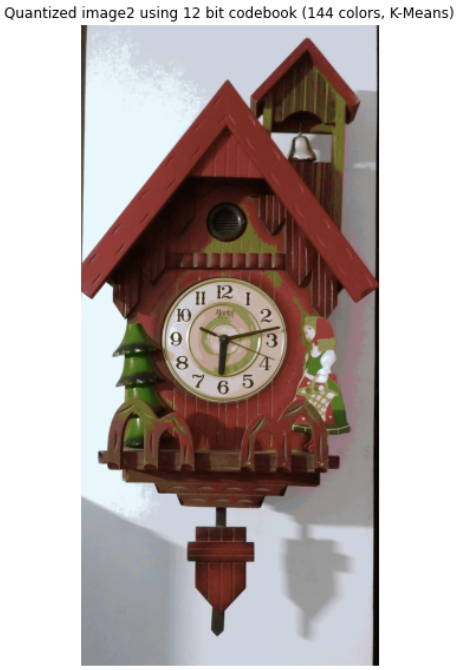
Features of reconstructed image:

- The reconstructed image is of the same size as the original image.
- The reconstructed image uses only 64 colors for the complete image.
- Since the similar colors are represented using the same “representative” color, the shades of the same color are not transformed smoothly.

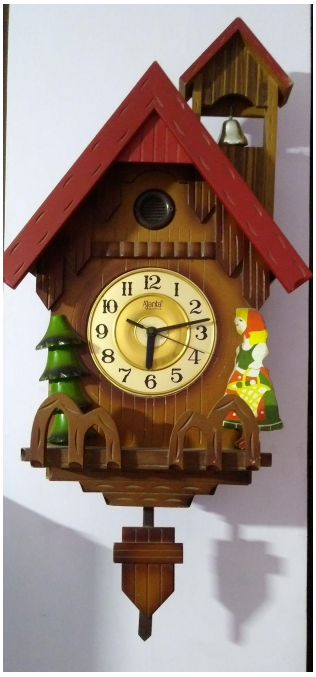
Differences observed:

- The reconstructed image here has more yellow shade than the previous one but still it can’t match the original image.
- The upper left corner and the lower left half is also better but still distorted.
- The complete clock is formed using a pair of shades of red which is not similar to the original one as it is brown in shade.
- The reconstructed image lacks clarity and sharpness too.
- Moreover the image is dull too.

VI. Reconstructing image2 (using 12 bit codebook)



Reconstructed Image



Original Image

Features of reconstructed image:

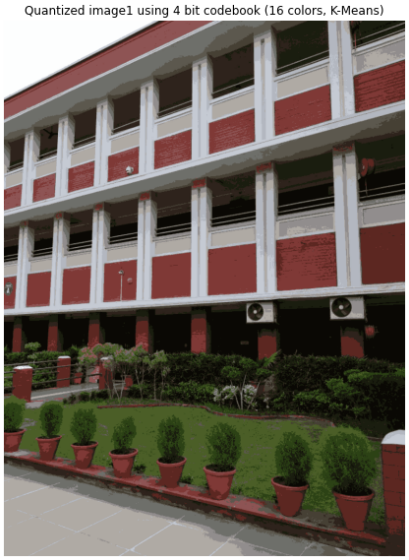
- The reconstructed image is of the same size as the original image.
- The reconstructed image uses only 144 colors for the complete image.
- Since the similar colors are represented using the same “representative” color, the shades of the same color are not transformed smoothly.

Differences observed:

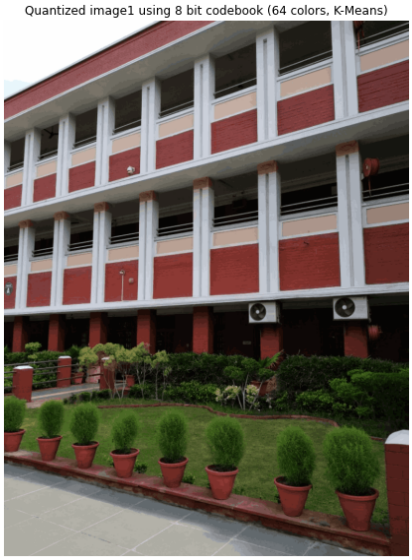
- The reconstructed image here has more yellow shade than the previous one but still it can’t match the original image.
- The upper left corner and the lower left half are also better.
- The tree on the left half is also not matching the original one.
- The reconstructed image lacks clarity and sharpness too.
- This image could be better if more yellow color was used to construct it.

Final Comparison among the images

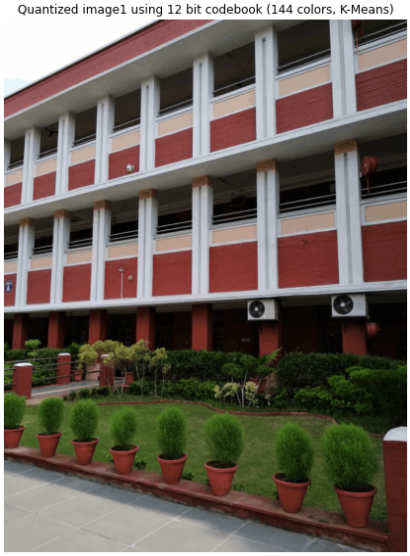
Image1:



16 COLORS

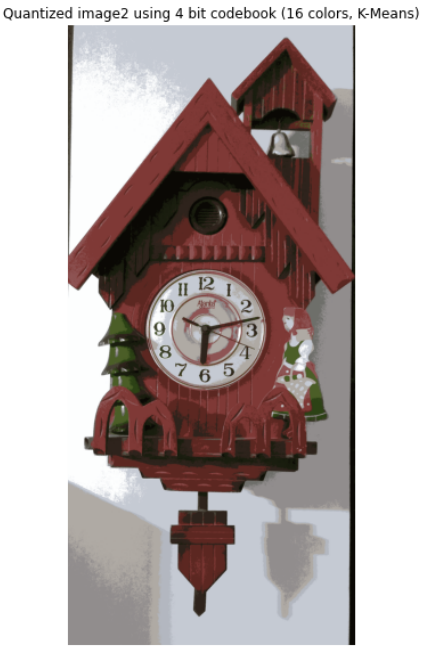


64 COLORS

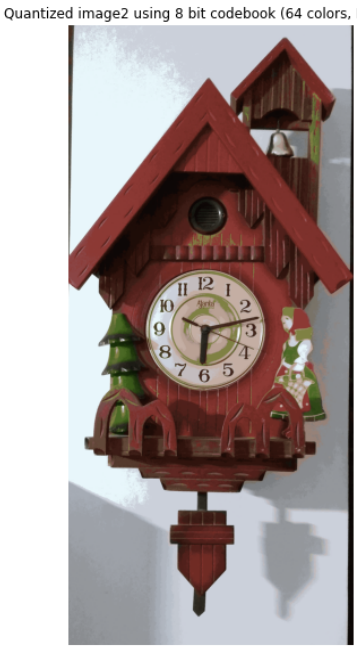


144 COLORS

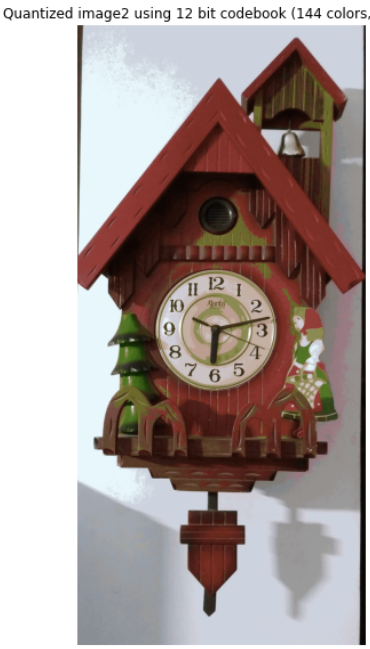
Image2:



16 COLORS



64 COLORS



144 COLORS

Final Conclusions:

We can conclude that if the image has less colors associated with it then the reconstruction can give a better result. Also the reconstruction can perform better if the image has more similar colors and less different ranging colors. Image1 was reconstructed better because it had less varying colors. Image 2 could be reconstructed better if the range of colors was increased so that yellow can also be covered.