Title: the amazing GWU building and amazing GWU people

**Problem Description:**

In this project, I take an image as the target image, and try to re-create this target image with a large collection of other items.

**Problem Methods:**

Part I. Data preparation

We first need to initialize some parameters, such as how many patches we need to segment from the target image. After we define “ratio of patch”, which means that number of patch spanning width of the target image[1] ,we can calculate the size of each patch, which can be calculated as:

*width of each patch = width of the target image/ ratio of patch*

We also need to check that height and width of each patch are proportional to the size of our target image.

Then we need to define two paths:

1. the path of the target image
2. the path of the folder of reference images

The size of the target image is obtained for further processing.

After we read all the reference images, we collect all of them into a cell called “patchs”.

Part II. Match and generate photo-mosaic

First, we calculate the average value for each patch.

Next, we loop for each tile of target image. We calculate the average value for each tile of target image[2]. We match a patch to a tile pair when the distance of them are closest among all the “patch-tile” pairs. The definition of “distance” here is the mean square error between the average value of a patch and a tile.

Part III. Visualization

In the visualization part, we try to visualize the reconstructed image by replacing the tiles in the target image with the corresponding resized patchs.

Target image selection:

Here is the target image, which is the entrance of the library. The format of the image is “jpeg” and the size of the image is 480\*1080 pixel.

A picture containing outdoor, building, stone, arch

Description automatically generated

Dataset selection:

I select the photos of 18 professors in GWU. In order to better present the target image, I tend to make the dataset more diverse, with different color of skin, different color of background, different age and different gender. Then, using the algorithm described above, I will realize photo-mosaic.

Experiment part:

I did the following experiments to explore photo-mosaic.

In Experiment 1, I change the *ratio of patch.*

In Experiment 2, I keep the ratio of patch and change the size of target image.

In Experiment 3, I keep the ratio of patch and the size of target image. Then, I change the way to calculate of “distance”.

Experiment1:

|  |  |
| --- | --- |
| ratio of patch | photo-mosaic result |
| 20 | A picture containing text, indoor, electronics  Description automatically generated |
| 50 | A close-up of a person  Description automatically generated with low confidence |
| 100 | A picture containing text, old  Description automatically generated |
| 200 | A picture containing text, outdoor, old  Description automatically generated |

I find that when the ration of patch increases, the result of photo-mosaic becomes better and better.

Experiment2:

Here I keep the ration of patch as 100 and resize the original target image.

|  |  |
| --- | --- |
| Size of target image | photo-mosaic result |
| 240\*540 | A picture containing text, old  Description automatically generated |
| 480\*1080 | A picture containing text, old  Description automatically generated |
| 960\*2160 | A close-up of a building  Description automatically generated with low confidence |

When I zoom in the result, I find that when the size of the target image become larger, the photo-mosaic result performs better in details.

Experiment3:

Here I keep the ratio of patch as 100 and the original size of target image. Then, I change the way to calculate of “distance” from L2 loss to L1 loss.

|  |  |
| --- | --- |
| loss function | photo-mosaic result |
| L2 loss | A picture containing text, old  Description automatically generated |
| L1 loss | A picture containing text, old  Description automatically generated |

The difference between the above two images seems not obvious. L1 loss and L2 loss performs similarly.

Conclusion:

* When the ration of patch increases, the result of photo-mosaic becomes better and better.
* When the size of the target image become larger, the photo-mosaic result performs better in details.
* Changing the type of loss function may not cause much difference.

**Problem Modification:**

After I compare the reconstructed image and the original target image, I find that there is still difference between the reconstructed image and the original target image. The reason is that our dataset lack of diversity. Thus, I decide to enlarge our dataset.

In the modification part, I finetune the parameters in order that the construction result can be as good as possible.

I mixed the “flower dataset” with my previous “professor dataset”. Flowers are one of the most colorful objects in the world and can represent a lot of features. During the experiment, I finetune the parameters in order to get the best result. Our flower dataset is downloaded from this link: <https://www.kaggle.com/datasets/olgabelitskaya/flower-color-images>. It contains 210 flower images.

We find that the result become much better than previous result!

|  |  |
| --- | --- |
| Target image | A picture containing outdoor, building, stone, arch  Description automatically generated |
| Previous result | A picture containing old, stone, arch  Description automatically generated |
| Current result  (Number of patch spanning width of img  = 100) | A collage of a building  Description automatically generated with low confidence |
| Current result  (Number of patch spanning width of img  = 200) | A picture containing text, outdoor  Description automatically generated |

Reference:

[1] <https://in.mathworks.com/matlabcentral/fileexchange/30904-manypieces>

[2] <https://in.mathworks.com/matlabcentral/fileexchange/636-photomosaic>