Image Reconstruction using spatial and geometrical information

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SLSWCS Student Workshop on Computer Science

Abstract

Nowadays, image reconstruction is widely used in many engineering and medical applications. In this work, an approach for reconstructing images is presented and demonstrated.

In this approach, images are reconstructed using its local feature descriptors and its geometric information. For each of the region of interest, visually similar patches are identified from the external image database. Based on the experimental results, an image can be approximately reconstructed using image local feature descriptors like SIFT.

Methodology

A technique based on local feature descriptors and its geometrical information, X,Y coordinates of local features is proposed to reconstruct images. This geometrical information is used to locate the exact point of the local feature descriptor

1. In the initial stage, training images are used to extract local feature descriptors. Extracted local feature descriptors with their corresponding geometrical information is used to generate a database of descriptors. SIFT descriptors are used to describe images. For example, each extracted descriptor is named as

$$\boldsymbol{D(i) = \{f(i), x(i), y(i), o(i), s(i), index(i)\}}$$

where

- $f(i) \in R^d$ - is the d dimensional of feature descriptor.
- $x(i), y(i)$ - are the spatial coordinates of the region of interest.
- $o(i), s(i)$- are the orientation and scale of the extracted feature descriptor.
- $index(i)$- is the index of the source image from which the feature descriptor was extracted.

2. During the testing time, local feature descriptors are extracted from the query image. Then, extract the suitable image patch from the original image database.
3. Mean Squared Error (MSE) is used to find out the overlapping areas of patches between the new patch that we want to add and patch already existing in the query image. In this experimental design, the upper threshold value of MSE is set as the default threshold (DT) ssin order to reduce overlapping patches.
4. If the threshold value of the new patch is greater than DT, then the new patch is considered as a non-overlapping patch with the existing patches that we already placed it into the query image. So, the new patch is fixed into the query image. Otherwise, the new patch is considered as a overlapping patch and no need to **fixed** into the query imagepairwise matching is used to find out the unknown nearest neighbor descriptor to build up the unknown image nearest neighbor descriptor for $T(j)$ from D.
5. The Nearest neighbor descriptor is used to

Dataset

- The performance of the proposed methodology is evaluated using ZuBuD Image Database. This database includes 201 building classes each have 5 images.
- Figure 1 depicts some example images from ZuBuD Image Database.

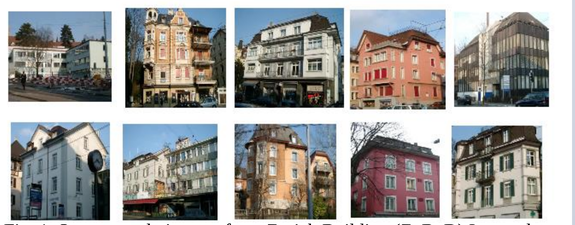

Fig. 1. Some sample images from Zurich Building (ZuBuD) Image dataset

Results

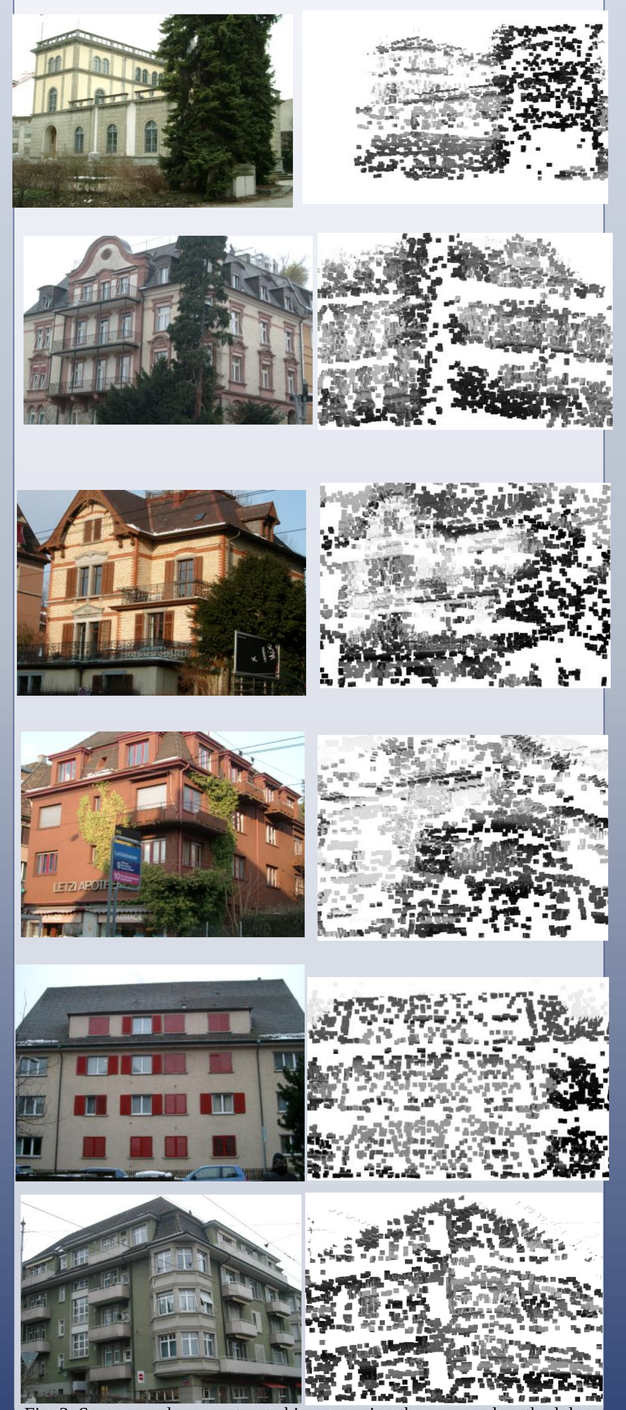

Fig. 2. Some sample reconstructed images using the proposed methodology

Experimental Design and testing results

- In these experiments, 20 building classes are randomly selected from the ZuBuD Image Database to calculate the performance of the proposed methodology. Set of parameters such as default threshold (DT) and size of the image patch are tunned with different values to get better reconstruction images.
- A Suitable image patch is selected using the nearest neighbour descriptor from the original image database. To select the suitable size of the image patch which is used to reconstruct images approximately, $3 \times 3, 6 \times 6$,and 11×11 sized patches are selected from the original image.
- Also, based on our testing results, 11×11 sized patches gives better-reconstructed images than other sized patches. So, 11×11 sized image patch is used in this experiment.
- Figure 2 gives some testing outputs of the proposed experimental design. Based on our testing outputs, this proposed approach progressively develops an approximation of the unknown image by constructing its region of interest one by one.

Conclusion

- This poster shows that an intensity image can be reconstructed using its spatial and geometrical information.
- The future work for this poster is mainly focusing on algorithm development to reconstruct images that doesn't have enough geometrical information.

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