The Decorative PixMosaics : Using Directional Photo Tiles

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Abstract

This paper introduces a new kind of mosaic, called the Decorative PixMosaic, where photo tiles of square shapes are used to compose the final image. We can express the resulting image with a similar color distribution of input images from small photo tiles. Based on an input image, user-selected edge features and a wide range of photo tiles, the method can both reproduce the image's textures and emphasize the selected edges by placing tiles that follow the edges. The voronoi site is situated in the center point of the tile using the Centroidal Voronoi Diagram for equally maintaining the distance among the tiles. To express the edges using tiles on the voronoi site as the center point, tiles do not cross image edges and are drawn up as following edge's direction. We use a distribution photo with similar color selected from the photo database. It is important to search for a visually similar photo. Hence we must have a large number of photo tiles.

Keywords--- **Photo Mosaics, Image Mosaics, Centroidal Voronoi Diagram, NPR**

1. Introduction

Non-Photorealistic Rendering is the general term for rendering techniques that use various painting materials. This paper suggests a new method which is simulated mosaic in the field of NPR.

Mosaic is an art technique which decorates the wall or floor of structure with small pieces such as marble or glass. It has developed into a method of pictorial presentation. Figure 1 is a mosaic of Greek Delos island representative of mosaic work during the Byzantine era. It is a large image generated using a collection of many small rectangle tiles. We can maximize the decorative effect with gaps between the non overlapping tiles.

For representing photographic images, Photo Mosaic(=PixMosaic) is composed of tiles, and has been developed and is used in commercial applications, such as posters and advertisements. Photo mosaic divides the input image into square lattices and then, assigns photos with the most analogous tone of color distribution for each lattice. Therefore, the mosaic fundamental principle is to depict a large image with the collection of small tiles. We can then generate various mosaic types according to the position, shape and texture of the tiles.

Figure 1. The practical Mosaic work of Greek Delos island

We generate modern photo mosaic using the position and direction of the tile which can be found in an existing classical mosaic.

2. Related work

In the computer graphics literature, the works most closely related to our approach are the various mosaicing algorithms that can be categorized by the choice of tiles and the restriction on their placement.

Simulated Decorative Mosaic[4] approaches the problem of aligning square tiles with varying orientations to preserve input image edges while maximizing the area covered by the colored tiles. This method obtains the satisfactory result image at input image having constant colors. But the input image with complicated color can't express the detailed area.

Photomosaic[7], Roberts Silver suggested, divided the input image into square grid. And then he kept each grid in photo tile. This way can present edges of input image into photo tile. However it shows the image with the low resolution. So this paper accentuated the edges in

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the input image with comprising of merits of those papers that has both good resolution and minute representation.

3. Mosaic rendering process

In this paper, we consider the elements in Table 1 and use the system flow shown in Figure 2 for creating a Decorative PixMosaic using square photo tiles.

element	explanation
Location	Position of square tile's center point
Direction	Direction of square tile as following edge
Texture	Texture(or color) of square tile

Table 1. The elements of tile

3.1. Location determination of Tile

The Decorative mosaic technique requires some regular spacing between uniform rectangle tiles. These spaces help smooth rotation and prevent them from concentrating in any specific position.

The centroidal voronoi diagram is necessary for this mosaic technique. It is based on the voronoi diagram. Initially, the voronoi diagram is divided into continuously from inducing point of an area. The boundary between voronoi sites, is determined by placing a line equidistant from the sites, perpendicular to the line connecting them. Figure 3(a) shows the results of generating several polygons by this method. The voronoi sites are located randomly, and the polygons vary in size and shape. Reiterative figured the voronoi sites relative to the polygon centroid is uplifted to smooth the results. So voronoi sites move position of the centroidal point little by little. The final polygon structure, in the centroidal voronoi diagram, is a regular sized polygon, like honeycomb as shown in the figure 3(b).

Finally the gaps among the tiles maintain, uniformity and the square tiles of comparable size are placed at the voronoi site to maintain this uniformity. There we can simulate the tiling method of a classic decorative mosaic.

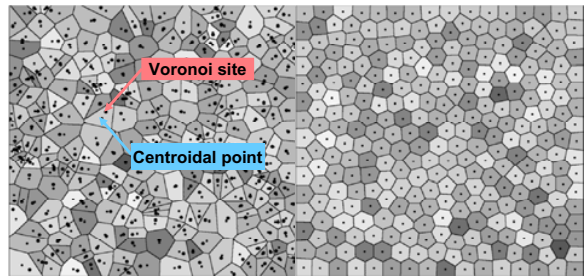

Figure 3. (a)Voronoi Diagram

(b)Centroidal Voronoi Diagram

3.2. Direction decision of Tile

The direction of the tile is an important matter with its position in the event generating photo mosaic using exact square tiles. A straight side of the tile is utilized for fixing its direction according to the properties of the exact rectangular. In this paper, the straight side is positioned parallel to the tangent of the closest edge from the central point of its tile. As explained in the previous paragraph, we distribute the central points then generate exact rectangular tiles regardless of the direction from those points. The straight side of the tile rotates so that it is parallel to the tangent of the closest edge. In this case, neighboring tiles on an edge have the similar directional properties since most of them follow the tangent of the surrounding edges. We assigned weights according to the proximity to edges then reduced the effect for tiles far from the edge. Tiles have direction according to the edge, such that there should be no problems to recognize objects with only uniform exact rectangular tiles. Edges that surrounded objects in the input image come into prominence. The effects of decoration are conspicuous with embossing edge by sequence according to the position of tiles and the spacing of them.

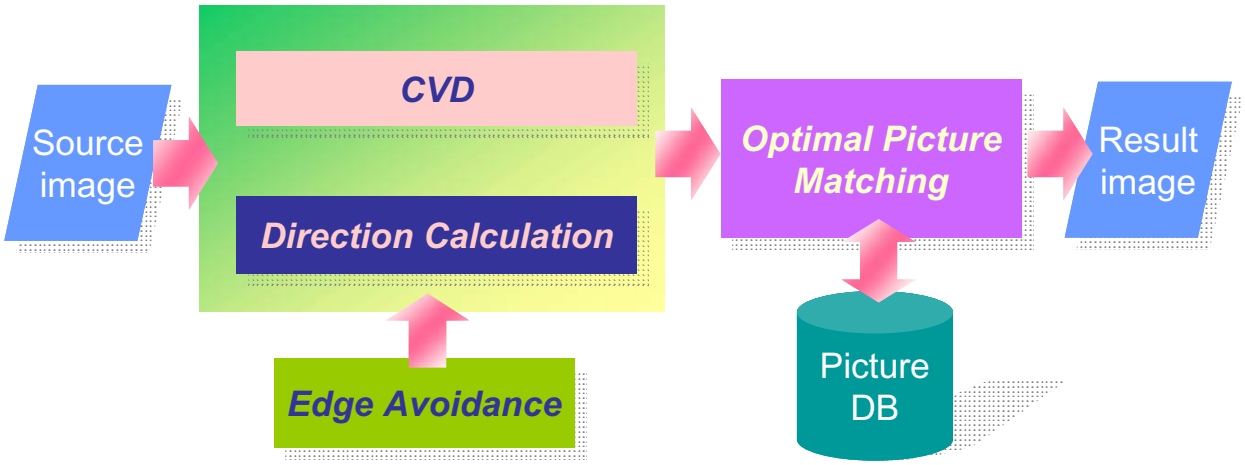

Figure 2. System flow

3.3. Edge expression

It can't be said to simulate completely only by fixing the position of tiles using the centroidal voronoi diagram then rotating parallel to the tangent of the nearest edge. One problem is that it is unconcerned about generating tiles above the edge area that is user selected.

A more significant feature for photo mosaic is representing the edge by taking advantage of space between tiles. In figure 4, the edge is represented by sequential spaces among tiles before the tiles are positioned while avoiding the edge. The edges are thickened, widening the spacing tile around the edge by iterative centroidal voronoi diagram. Reusing the centroidal voroni diagram except with thick edge lines, narrows those widened spaces induced by tiles. Then, until it is similar to the spaces between tiles around the edge, CVD is performed iteratively by user. This method follows the direction of the edge, and more importantly avoids placing tiles on the edge. For this way the last position and direction of tiles are fixed. We can generate photo mosaic images by only fixing color or texture of the tile for the next step. In the following section, the technique is explained to create a similar image as a vision, applying the texture of tiles.

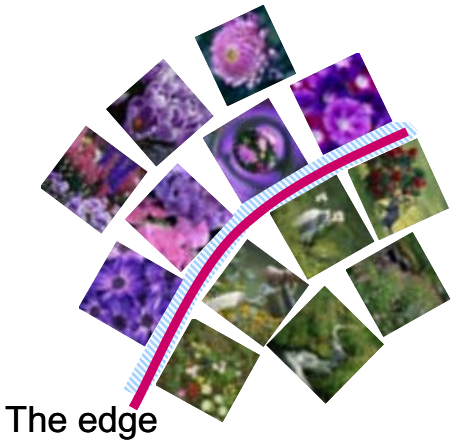

Figure 4. Edge Avoidance

3.4. Optimal Photo Matching

There is only a representation of one constant color in each texture of the tile from the existing Decorative Mosaics. This technique uses color decision method by sampling the average color value in the input image's same position.

This paper presents a new method using photos as textures for tiles and is different from existing method. We must have many various photos to satisfy tile regions having diverse color information. This research used 10700 pieces of flower photos. For the main subject expression, it is effective to produce a photo mosaic as photos having common subjects, such as people, animals, flowers, cars. It is easy to match tiles since tile shape preprocess as a square shape. When creating a mosaic database, information such as photo file name, average color value of the total region and color information of the tile region is saved. And tile matching time is reduced by eliminating the first photo having a definite difference of average color value compared to the candidate tiles. Next, we search for and optimal photo as using the original tile to select candidate tiles.

The optimal photo is the photo having most similar color distribution in tile region of the input image. It is very important work to search it at this research. Figure 5 shows the tile region of a source image and a photo tile. We choose small candidate tiles among photo database that have a value within the proper range using the following formula. Managed thus, we search for the photo having similar color distribution. Then, finally, we select the tile having the shortest color distance as the final photo tile among candidate tiles in pixel comparison. The selected photo is placed in the rotated tile region matching with the input image.

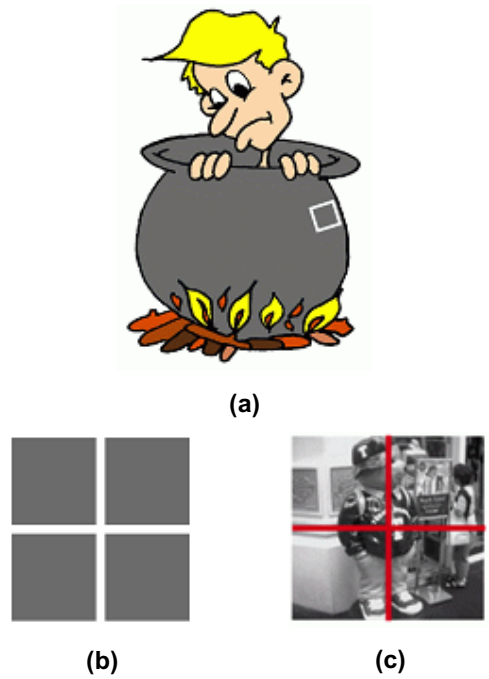

Figure 5. (a)The input image (b)Tile region in the input image (c) The picture tile

4. Conclusion

In this study, we determined the location and direction of tiles for a decorative effect in the input image. We suggest creating a photo mosaic image using photos as tiles' texture. This method emphasizes edges of the input image as it merges classical and modern features. This is necessary to recognize the object because user-selected edges are represented using the straight side of a tile. And then we create a gorgeous

photo mosaic since we use photos having various colors and patterns similar to the tile's texture. This paper presents a method to decide position and direction of tile using user-selected edge in source image. We will automatically extract the object's edge using segmentation method in the source image and search for the most suitable photo to express the edge detail using its color in the future. In future work, we will adapt this method to segment the object in the source image by layers.

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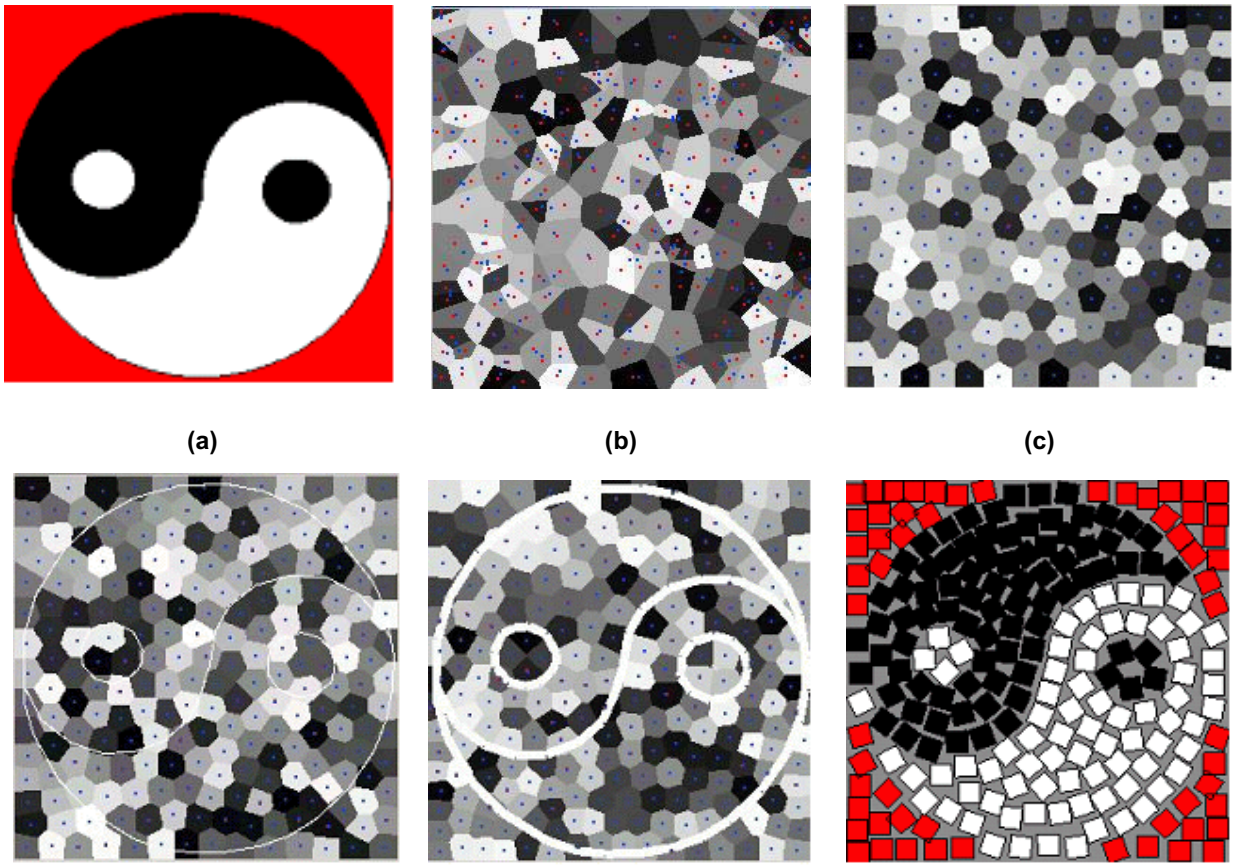
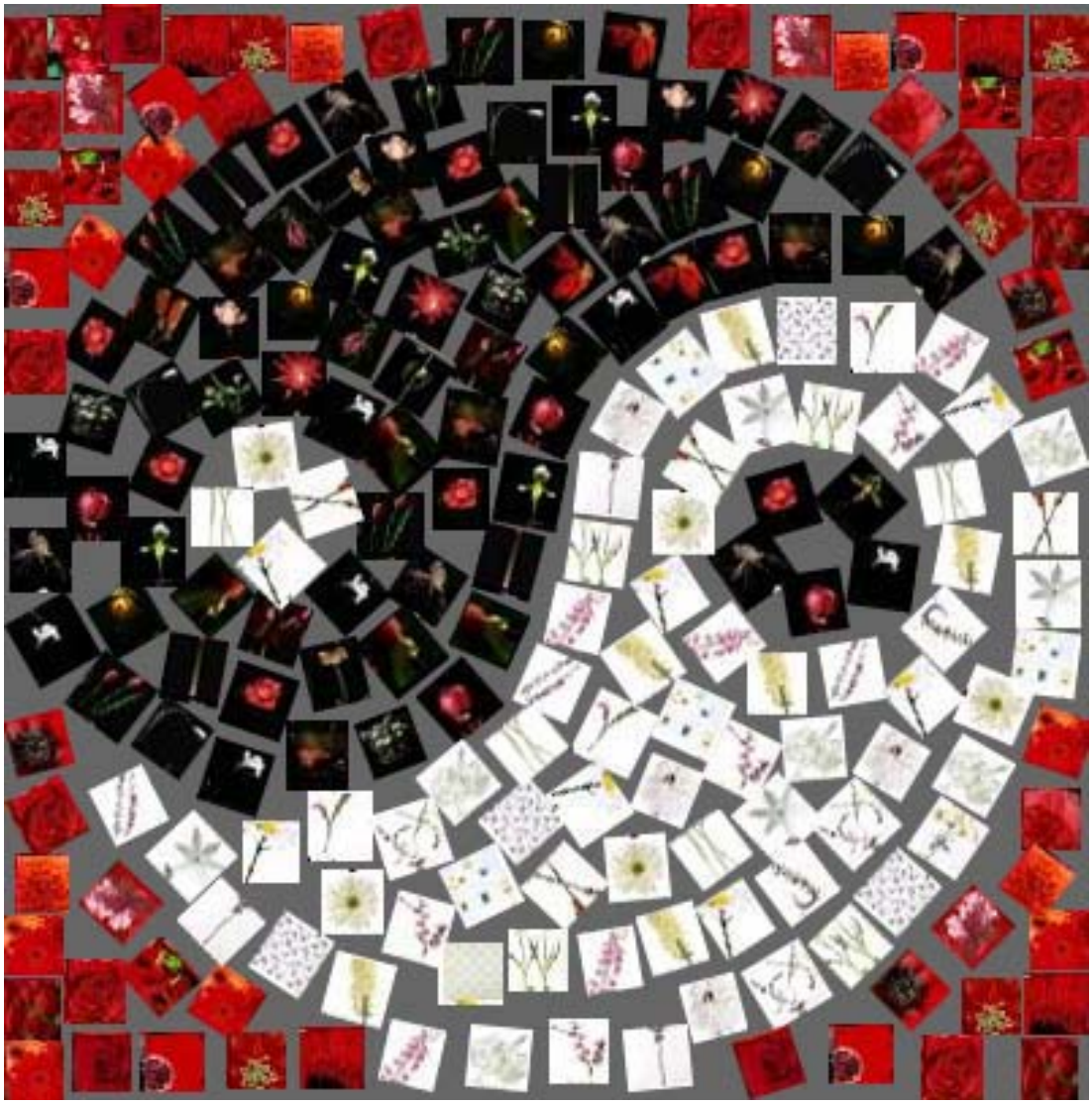


(a) (b) (c)

(d) (e) (f)



(g)

Figure 6. (a)The source image (b)Generation of Voronoi Diagram (c)Generation of Centroidal Voronoi Diagram (d)Edges' expression by user-selected (e)Generation CVD using thick edge line (edge avoidance) (f)Generation constant color tile using average color sampling (g)Photo matching in tile region

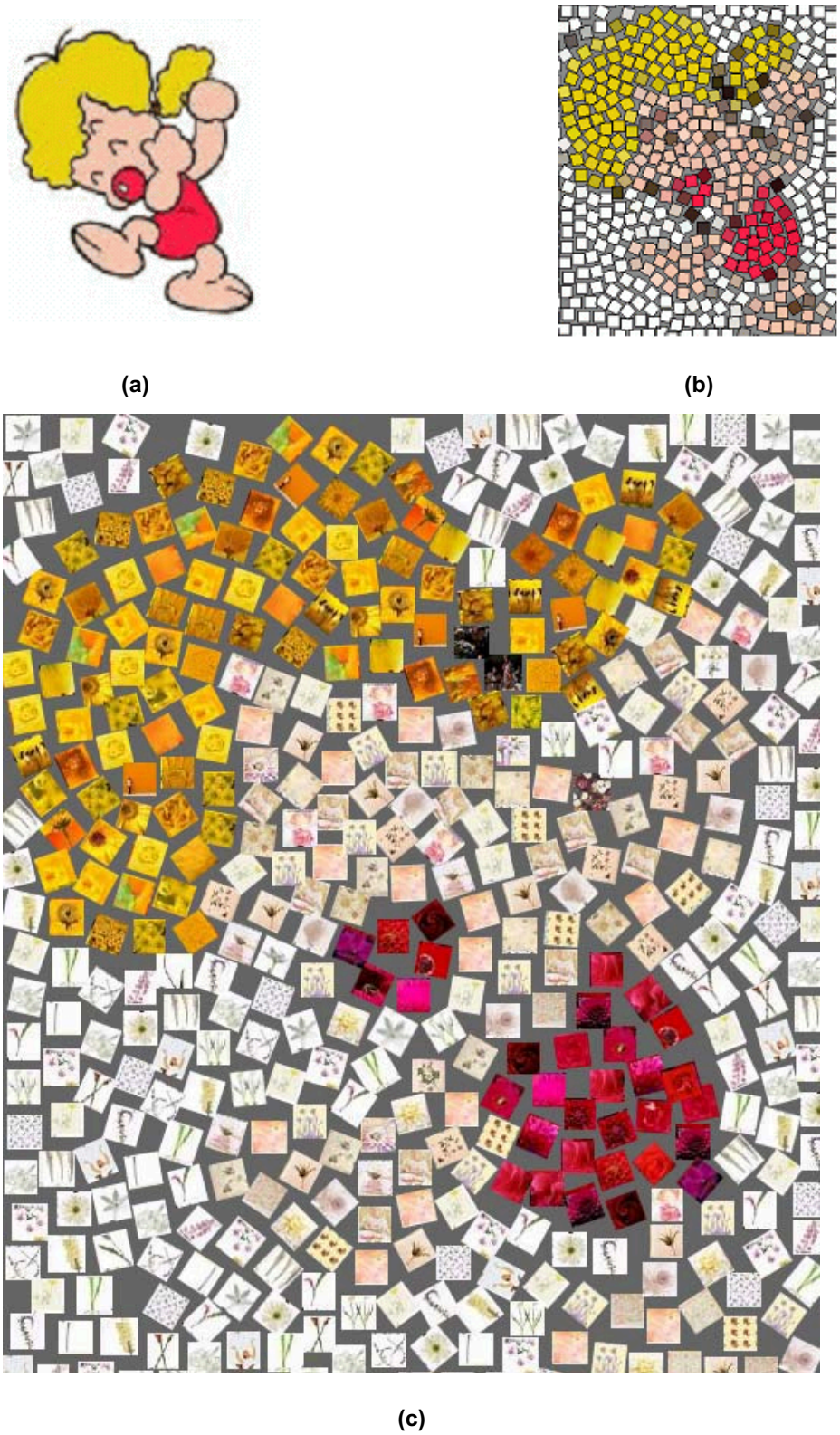


Figure 7. (a) The source image (b)Generation constant color tile using average color sampling (c) Photo matching in tile region