

# Efficient paper mosaic rendering on mobile devices based on position-based tiling

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**Abstract** According to the growth of mobile technology, people experience high-performance mobile devices. In this environment, processing in real-time is required for mobile application. For colored paper mosaic application on mobile devices, the problem regarding speed must be solved while maintaining high-quality. In this paper, we propose an accelerated method that generates tiles based on their position. We locate tiles by considering the edges of the image and the shapes of neighbor tiles. The shape of the tiles is determined based on the position of each tile. In addition, we display the generation process of a result for our method be seemed real-time method. In here, we propose an ordering method that is similar to the ordering method of humans by considering color, edge, distance and direction.

## 1 Introduction

Nowadays, improvement of mobile technology leads to the development of high-performance mobile devices such as smart phones and tablet PCs. By enhanced performance of mobile devices, such as the multi-core smart phone, many applications are developed on mobile devices which were not possible before. Huge applications running on mobile devices surprised users at first. But, after users experienced high-performance mobile devices, they cannot be satisfied

with applications which performed slowly. In this environment, Non-photorealistic rendering (NPR), a technique converting the form of input images to the form of human-friendly images like paintings, cartoon, etc., came into use for mobile applications (Fig. 1). The method of Seo et al. [18], converting input images to painting style images, was developed as xPaintMachine [19], and the method of Lee et al. [14], transforming the style of a reference image into an input image, was implemented as Camvas painting [13]. In addition, coin mosaic rendering [15], representing result images by various stacked coins, was implemented as mobile application [10], and Image Cartooning [21] was developed as ToonPAINT [20]. Users can create characteristic images by these applications and can share these images on social network services (SNS) directly. Especially, some of these techniques by Seo et al. [18] and Lee et al. present the generating process of a result to overcome the limitation of rendering speed that cannot generate a result immediately.

Colored paper mosaic (Fig. 2), an artwork representing the target by attaching scraps of colored paper to the canvas, is one of the most characteristic NPR techniques. The various sizes and shapes of paper scraps, irregular patterns at the boundaries of paper scraps and appeared white bottom layer at the boundaries are the unique features of the colored paper mosaic. Although previous studies [6, 17] that simulate colored paper mosaic provide human-friendly results, colored paper mosaic rendering is not implemented on mobile devices yet. It is because of the limitations of previous studies. Method of Seo et al. [17] can generate a result in reasonable time, but its results cannot maintain the edges of the input image, and method of Gi et al. [6] arranges tiles to express the edges of the input image, but requires too much computing time. For the implementation of colored paper mosaic rendering on mobile devices, high-

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