The Application of Neutral Vision Models to the Detection of Illusory Shapes for Trademark Images

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Abstract

Due to the limitation of text-based image retrieval systems [1], many image databases are currently indexed and retrieved based on their shapes, textures, and colours, etc.. The early-developed system, namely ARTISAN, for indexing and retrieval of trademark images are developed based on shape features [2]. By given a query image, one can use the system to search the whole database and to retrieve images with similar shapes.

However most shape representation techniques have difficulty to retrieve an illusory shape because such an appearance is constructed in three-dimension by two human eyes. In this study, further modifications of the ARTISAN system have been made for the retrieval of images with illusory shapes. The modification was based on the application of a human perception model, FAÇADE, developed by Grossberg and Mingolla [3-5]. In brief, real contours and illusory contours of trademark images are segmented and detected. The first stage involves the application of oriented masks (J_{ijk} in the models) to the original image to establish real contour (or figure) boundaries of the image. This is obtained by calculating non-zero Y_{ijk} values (after a low-pass filter) via selecting appropriate constant parameters. The subsequent stage is to find the centre position where illusory phenomena might be generated. This is achieved by amodal filling in the ground area that is surrounded by figure boundaries with different grey levels. According to Gestalt rules, illusory vision only happens between real contour boundaries. The filling in is completed by finding the largest circle containing only one grey level value centred at each pixel position, yielding a circle-centre field. For trademark images, only two grey levels are applicable i.e., background and image patterns. They are denoted as 0 and 1. If real contour boundaries have grey value of 1, the illusory contours are to be perceived with the grey level of 0.

Of all the circles on every pixel, the pixel position with the largest radius value will be treated as the centre of illusory. This position is also the centre of the inscribed circle within the illusory area. Following the centring of the inscribed circle of illusory contour, the boundary of the illusory is traced by scanning from 0° to 360° using radiating rays. The first non-zero value of circle-centre field constrained by oriented mask J_{ijk} field of the boundary model reached by the ray will be one of the positions forming illusory boundary. Linking of all these positions will generate an initial illusory contour pattern that can be further refined by combining circle-centre field with Y_{ijk} field.

For each segment of both real and illusory patterns, further processing such as calculation of invariant values will be carried out by the original ARTISAN system.

Preliminary results show that this method works well for most images with illusory contours and textures. It can be used to detect both real and illusory figures and is not only much faster but also fills in the gaps of finding illusory patterns for the ARTISAN system. At present, illusory lines can not be traced using the current system developed because the technique utilises inscribed circle to find illusory contour centre. Further modification is required in these directions.

Reference:

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