Circle Block Based Copy-Move Forgery Detection

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ABSTRACT - Copy-Move-Forgery (CMF) is one of the common ways of tampering digital images. Forging an image has become very easy and visually confusing to detect it from the authentic one. Broadly speaking, CMF detection methods generally use either block-based or feature point-based approaches. In this paper, we proposed a new technique called key-point based Circle-Block model in which first key-points are extracted; then Circle-blocks are constructed centering the keypoints. Block matching is made using color and pixels behavior of the blocks.

Keywords: Copy-Move, Forgery Detection, Circle Block, Block Based.

1. INTRODUCTION

Most of existing CMFD methods belong to either block-based or key-point based. In this paper, we presented a novel method which is somehow a hybrid form of the two methods. In which four concentric circular blocks are segmented centering SIFT features. Then, feature matching is made based on the behavior pixels inside the circles.

2. Proposed Procedure for Forgery Detection

2.1. Circle Block Model

The traditional block based methods segments the input image into blocks of regular shapes such as squares, which are sensitive to rotations. As shown in [1], circle blocks are more robust to rotation compared to square blocks. As can be seen from the fig 1, simple rotation can significantly affect the relationship between the copied and the pasted regions. In fig. 1(a), the black square without rotating forgery part ( $R = 0^\circ$) shows how image segmentation could be performed after the copied part is rotated( $R = 45^\circ$)

![Fig. 1. (a).model with square block. (b). Model with circle block](image)

After the copied region is rotated $R = 45^\circ$ and pasted the region inside the original black square is tilted and will not be matched with a similar segmentation using the red square block. However, a circle centering at a key-point covers similar regions before and after the forgery (fig 1.b).
2.2. Feature Extraction

For the proposed algorithm, Scale Invariant Feature Transform (SIFT) points are extracted first. Then 4-concentric circles are drawn around each SIFT features. Feature matching is made using pixels statistics and dominant colors of each circular block.

\[
\Gamma_i = \frac{\sum_{j,k} x_{j,k}}{|\omega|} \quad \text{-- Eq. 1}
\]

Where \( \Gamma_i \) and \( \sum x_i \) respectively denote the sum and the mean of pixel values located in the \( i \)-th circular block. And \( |\omega| \) denotes the cardinality of pixels inside the \( i \)-th circle. The means of the concentric circles are robust against rotation, blurring, noise addition and JPEG compression and could be used as the image features\([1]\). Let \( V_1 \) and \( V_2 \) of any similarity vectors of two regions, their similarity \( \delta \), is given given by the \( L \) norm given in Equation 2.

\[
\delta(V_1, V_2) = \sqrt{\sum (\Gamma_i - \Gamma_{i2})^2} \quad \text{-- Eq. 2}
\]

Where \( \Gamma_{i,k=1,2} \) and \( \Gamma_{i=1,2,3,4} \) denotes features of the first and the second regions. The pixel statistic vectors \( V_1 \) and \( V_2 \) of blocks 1 and 2 is given by Equation 3.

\[
V_1 = [\delta_{11}, \delta_{12}, \delta_{13}, \delta_{14}]
\]

\[
V_2 = [\delta_{21}, \delta_{22}, \delta_{23}, \delta_{24}] \quad \text{-- Eq. 3}
\]

To determine color dominancy, for each of the four concentric circular blocks the n dominant colors are extracted. Then the top T dominant colors are considered as features of the image blocks.

2.3. Feature Matching

Blocks similarity is determined by matching the pixels statistics and dominant color vectors. For color based similarity analysis, we used a filter to reduce the variants of same color due to brightness and gradients. We took the top 4 dominant colors as block features. We perform a series of tests to check the behavior of color dominancy with respect to geometric transformations such as rotation, scaling and blurring. Color dominancy is invariant to rotation and robust to scaling and a bit tolerant to blurring. We set a color threshold value \( TC=0 \), spatial threshold \( Cd=10 \), and similarity threshold \( SM=0.003 \).

REFERENCES