DWT Based Copy-Move Image Forgery Detection

Preeti Yadav , Yogesh Rathore , Aarti Yadu

Abstract— In an age with digital media, it is no longer true that seeing is believing. In addition, digital forgeries can be indistinguishable from authentic photographs. In a copy-move image forgery, a part of an image is copied and then pasted on a different location within the same image. In this paper an improved algorithm based on Discrete Wavelet Transform (DWT) is used to detect such cloning forgery. In this technique DWT (Discrete Wavelet Transform) is applied to the input image to yield a reduced dimensional representation. After that compressed image is divided into overlapping blocks. These blocks are then sorted and duplicated blocks are identified. Due to DWT usage, detection is first carried out on lowest level image representation so this Copy-Move detection process increases accuracy of detection process.

Keywords— Digital Tempering, DWT Copy-Move forgery.

I. INTRODUCTION

Copy-Move forgery is performed with the intention to make an object “disappear” from the image by covering it with a small block copied from another part of the same image[1].

Usually, such an image tampering is done with the aim of either hiding some image details, in which case a background is duplicated, or adding more details. Whichever the case, image integrity is lost. Because the copied segments come from the same image, the color palette, noise components, dynamic range and the other properties will be compatible with the rest of the image, thus it is very difficult for a human eye to detect. Sometimes, even it makes harder for technology to detect the forgery, if the image is retouched with the tools that are available.

![Example of Copy-Move forgery](image1)

Figure 1. Example of Copy-Move forgery (a) original image (b) tampered image

II. LITERATURE REVIEW

Since the key characteristics of Copy-Move forgery is that the copied part and the pasted part are in the same image, one method to detect this forgery is exhaustive search, but it is computationally complex and more time is needed for detection. A. C. Popescu and H. Farid proposed a similar detection method [2], in which the image blocks are reduced in dimension by using Principal Component Analysis (PCA). But the efficiency of detection algorithm was not good, because, blocks are directly extracted from the original image, resulting in a large number of blocks. D. Soukal, proposes DCT based copy-move forgery detection method based on SURF, which detects duplication region with different size. Experimental result shows that the proposed method can detect copy-move forgery with minimum false match for images with high resolution [4]. To increase the speed of operation process many researchers use blocking approaches [5]. G.Li, Q.Wu, D.Tu developed a sorted neighborhood method based on DWT (Discrete Wavelet Transform) and SVD (Singular Value Decomposition) [6]. In this method the computation of SVD takes lot of time and it is computationally complex.

III. PROPOSED METHOD

In this proposed method an image is scanned from the upper left corner to the lower right corner while sliding a BxB block. The DWT transform is calculated For each block, the DWT coefficients are stored as one row in the matrix A. The matrix will have \((M+B+1)(N+B+1)\) rows and \(BxB\) columns. The rows of A are lexicographically sorted. The DWT coefficients for each block are now being compared instead of the pixel representation, if two successive rows of the sorted matrix A are found, the algorithm stores the positions of the matching blocks in a separate list B and increments a shift-vector counter C. For all normalized shift vectors, the matching blocks that contributed to that specific shift vector are colored with the same color and thus identified as segments that might have been copied and moved.

The Proposed method of copy-move forgery detection has following main parts.
1. Discrete Wavelet Transform
2. Lexicographic Sorting
3. Shift Vector Calculation
4. Neighbor block matching

3.1 Discrete Wavelet Transform

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Wavelet decomposition of the images is used due to its inherent multiresolution characteristics. The basic idea of using Discrete Wavelet Transform is to reduce the size of the image at each level, e.g., a square image of size \(2^j \times 2^j\) pixels at level-1 reduces to size \(2^{j-1} \times 2^{j-1}\) pixels at level \(L+1\). At each level, the image is decomposed into four sub images. The sub images are labeled LL, LH, HL and HH. The notation LH, HL and HH correspond to the vertical, horizontal and diagonal components of the image respectively. LL corresponds to the coarse level coefficients or the approximation image. This image (LL) is used for further decomposition. These sub images can be combined together to restore the previous image which was decomposed.

Below figure shows the image pyramid[7]. Level-0 image is used for matching of blocks and then these matched blocks are carried to the next higher level. Final match is performed on the original image itself.

![Image pyramid](image)

**Figure 2. Image pyramid**

### 3.2 Lexicographic Sort

The lexicographic or lexicographical order, (also known as lexical order, dictionary order, alphabetical order or lexicographical product), is a generalization of the way the alphabetical order of words is based on the alphabetical order of letters.

An important property of the lexicographical order is that it preserves well-orders, that is, if \(I\) and \(J\) are well-ordered sets, then the product set \(I \times J\) with the lexicographical order is also well-ordered[8].

In this step lexicographic sorting is performed on the rows of matrix \(A\), if two consecutive rows of the sorted matrix \(A\) are found, the algorithm stores the positions of the identical blocks in a separate list \(B\) and increments a shift-vector counter \(C\).

### 3.3 Shift Vector Calculation

Let \((x_1, y_1)\) and \((x_2, y_2)\) be the positions of the two matching blocks. The shift vector \(s\) between the two matching blocks is calculated as

\[ s = (s_1, s_2) = (x_1 - y_1, x_2 - y_2) \]

Because the shift vectors \(s\) and \(s\) correspond to the same shift, the shift vectors \(s\) are normalized[9].

The normalized shift vectors \(s(1), s(2), ..., s(K)\), are those whose occurrence exceeds a user-specified threshold \(T\): \(C(s(g)) > T\) for all \(g = 1, ..., K\).

#### 3.4 Neighbor Shift Matching

For a suspected pair of blocks, the system compares features of nearby blocks of both of the blocks of a pair which are at the same vector distance from the corresponding block. Neighbor Shift value is calculated by subtracting two equivalent feature vectors. Shift vector of the entire suspected duplicate region will be same. Two copied and then moved areas will yield some pair of identical features. The same shift vector will be formed by this. For a particular number of neighbors this shift vector will be checked. Same shift vector will be showing the duplicated region.

### IV. EXPERIMENTAL RESULT

![Copy-Move Forgery detection result](image)

**Figure 3. Forgery detection result (16*16)(a) original image(b) tampered image (c) detection result**

![Copy-Move Forgery detection result](image)

**Figure 4. Copy-Move Forgery detection result (48*48) (a) original image (b) tampered image (c) detection result**

### TABLE I. COMPARISON WITH DIFFERENT SIZED COPY-MOVE IMAGE REGION

<table>
<thead>
<tr>
<th>Image Size</th>
<th>Copy-Move Region</th>
<th>Matched Region</th>
<th>Accuracy in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>No of Pixels</td>
<td>No of Pixels</td>
<td></td>
</tr>
<tr>
<td>256x256</td>
<td>16x16</td>
<td>256</td>
<td>100%</td>
</tr>
<tr>
<td>256x256</td>
<td>48x48</td>
<td>2304</td>
<td>96%</td>
</tr>
</tbody>
</table>

### V. CONCLUSION

In this paper an algorithm for detecting copy move forgery using Discrete Wavelet Transform (DWT) is proposed. Our algorithm has lower computational complexity, since exhaustive search for identical blocks is performed only on the image at the lowest resolution. In future, I would like to apply Principal Component Analysis, PCA, to the feature...
vector to reduce its dimension, so time complexity will be reduced. The algorithm gave best performance for detection of small size copy move forgery.

REFERENCES


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