Project Report

Vandita Agarwal
M20MA208
agarwal.15@iitj.ac.in

Dattatreyo Roy
M22CS060
m22cs060@iitj.ac.in

Shilajit Banerjee
M22CS062
m22cs062@iitj.ac.in

Abstract

The main objective of the project is to explore different ways of protecting image copyright through image watermarking and identifying potential flaws in the process. The project will implement watermarking techniques such as visible and invisible watermarking through logos and text and evaluate their effectiveness in protecting copyright. After then it will implement techniques to remove that watermark from the watermarked images, so as to receive almost original images again. The project will also explore potential flaws or weaknesses in the watermarking process and develop strategies to strengthen image protection. Ultimately, it will also use evaluation measures to check watermarking techniques used and give results accordingly, so that we could compare these techniques.

1. Introduction

Image watermarking is that complex process which involves various techniques and methods to protect digital images. Visible watermarks are commonly used by overlaying images with transparent logos or text to identify the owner or copyright holder. Invisible watermarks are also utilized to embed digital information into the image data for more subtle protection. Also, in some cases security key is also used on watermark before applying it on images. Watermarking can be applied to various image types and provides effective protection against unauthorized use. However, the level of protection can vary depending on the technique used and the skill of the person attempting to remove the watermark. Overall, watermarking remains an essential tool for content creators and copyright holders.

2. Related Work

Several notable works have been published regarding image watermarking by several authors. Ossama R. Abouelseoud and Ahmed M. Badawi's "A Survey of Digital Image Watermarking Techniques" provides an overview of the various watermarking techniques used in digital images. We have also seen Dong-Hwan Har's "A Survey of Visible Watermarking Techniques and Applications" explores different visible watermarking techniques and their applications in various fields. Again, G. V. R. S. Prasad and R. P. Jagadeesh Chandra Bose's "A Survey on Invisible Watermarking Techniques for Digital Image Protection" provides an overview of the different invisible watermarking techniques used in digital images. Last but not the least, Suresh Kumar's "Robust and Secure Image Watermarking Techniques: A Review" provides a comprehensive review of the different robust and secure watermarking techniques used in digital images. These works serve as valuable resources for researchers and professionals in the field of image watermarking, providing insights into the current state of the technology and its applications.

3. Types of Approach

Here, we are presenting different approaches for the watermarking process. All these approaches can be easily implemented through opencv and python which has been our primary usage.

3.1. Image Watermarking through Logo

Image marking using the logo is a useful method used for branding, copyright protection, and advertising. This involves the addition of a random logo or symbol to a sample image. That logo can be placed in a visible location, such as the bottom corner of the image, to make it easily recognizable which has been implemented by us.

The advantage of using a logo for image marking is that it is easy to make and customize as per our need. A logo can be used repeatedly across multiple images. Also, the logo is seen as a tool to portray a professional touch to images, making them more appealing to viewers. Here, we should choose a unique logo created by the user only.

3.2. Image Watermarking by Text

Image watermarking by text is the process of adding visible or invisible text to an image for branding, copyright protection, or identification purposes. Visible text watermarks can be placed in different locations with various fonts, sizes,

and colors. Invisible text watermarks are embedded into the image data and cannot be seen by the naked eye. Text watermarks are more difficult to remove or alter than logos, but they can be distracting to viewers and take away from the image's aesthetic. It is important to choose subtle fonts, sizes, and colors that do not detract from the overall image. Text watermarks can convey important information, such as copyright notices.

3.3. Invisible Watermarking

Invisible watermarking is a technique used to embed digital information into an image without altering its visible appearance. This technique involves using algorithms to modify the pixel values of an image to embed the watermark. Invisible watermarks are used for identification, copyright protection, and tamper detection. They are difficult to detect or remove without specialized software, making them a reliable tool for image protection. However, invisible watermarks can be vulnerable to attacks such as compression, cropping, and filtering.

4. Dataset Collection

Here, we have created our own dataset for the image watermarking such that we can emphasize on the originality of our work. We have created a master dataset containing the pictures of different cities in Rajasthan. In the course of these few months in Jodhpur, we have visited several places in rajasthan and we have fought to use watermarking to preserve its ownership. Our purpose is to protect its ownership. We have visited different cities such as Jodhpur, Jaipur, Ajmer, Pushkar and Jaisalmer.

Dataset Details: i. Category: Travel Places in Rajasthan

ii. Number of Images: 500+ These are two of the sample images from the dataset that has been collected by us.

We can use this dataset for any purpose in the future.

Figure 1. Sample image of our dataset(1)

5. Work Done

In our experimentation, we have used a random selection of images and logos to demonstrate the implementation of watermarking through logo(both normal logo and rotated logo) and text. We have also explored the use of

Figure 2. Sample image of our dataset(2)

invisible watermarking, which involves embedding digital information within the image without altering its visible appearance. Our next step is to apply these techniques to a larger dataset(containing 500+ images) that we have collected, which will allow us to test the efficacy of these techniques on a broader range of images.

5.1. Adding Watermark

Here, we are adding two types of image-watermark and text watermark. For image watermarks, we have added two types of watermarks, normal watermark and rotated watermark(by 90 degrees). We have experimented this on our dataset and have stored the results in a separate folder.

5.2. Removing Watermark

In the this step, we have tried removing these image watermarks from the watermarked images in order to achieve almost original images back, which can be useful for image editing and manipulation purposes. Firstly, we have tried removing image watermark and calculated loss between original and removed watermarked images. Then secondly we have tried removing text watermark using image inpainting with two techniques and again calculated loss between these original and watermarked images.

5.2.1 Removal of normal image watermark

For the first part of image watermark removal, firstly we have resized the watermarked image to a fixed size of 600*600 pixels to get more clarity. Then template matching is performed to locate logo in the watermarked image. After finding the logo in the watermarked image, we have located top-left and bottom-right corners of the logo in the image. Then created a mask of the area where the logo is located. And the mask is initialized as an array of zeros with the same shape as the input image, and then the pixels within the region where the logo is located are set to 255. Then we have used this mask to inpaint the area where the logo is located using surrounding pixels.

5.2.2 Removal of rotated image watermark

Here, we have used two types of methods. We have made a function siftmatching which takes a list of images and removes a watermark by template matching and SIFT method. It uses the SIFT algorithm to find keypoints and descriptors in the template and the original image, then matches them using a Brute-Force Matcher. The homography matrix is calculated using the matched keypoints, and the watermark is removed using inpainting.

Another way is using the ORB method where the orb function takes in a list of images and a watermark, and returns the detected and removed watermark images, along with three types of loss measures. It first detects the watermark using ORB feature detection and matching it to a template image. It then uses the detected region to create a mask and inpaint the watermark area.

5.2.3 Removal of text watermark

For the second part of text watermark removal, firstly we have converted the watermarked image to grayscale and apply adaptive thresholding to convert it into binary image and preprocess it. After that we have found contours in the resultant image. Then we ran a loop over these contours to detect the text region in the image. If the text is detected, fill the region with surrounding pixels using inpainting.

We have also tried another technique for the same purpose, for that it has used a function which uses an OCR pipeline to detect the location of text in an image and creates a mask of the text regions. It then uses the mask to inpaint the text region, resulting in an image with the text removed.

6. Experiments and Results

We have performed the image watermarking and watermark removal on our dataset and below is the results obtained by us. We have done our experiments on a dataset of size 500+ images. First of all, we have added normal image watermark on these images.

And Figure 3,4 are the images of normal logo and rotated logo respectively we have used as watermark for our images.

Figure 5 is the resultant set of images after addition of normal logo in the images.

Then, we have added the rotated logo watermark in our images(Figure 6).

Here(Figure 7,8,9) are the representations of some mean squared losses occured after the addition of watermarks in the images.

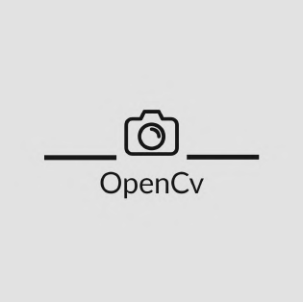

Figure 3. Logo image

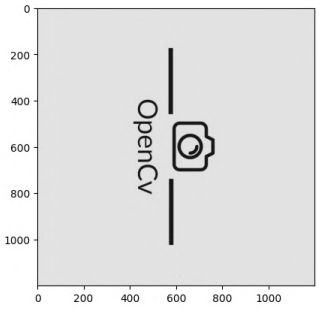

Figure 4. Rotated Logo image

Figure 5. Set of Image watermarking

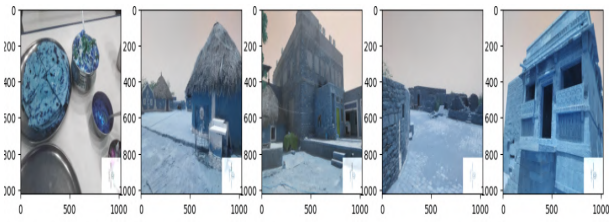

Figure 6. Set of rotated Watermarked Images

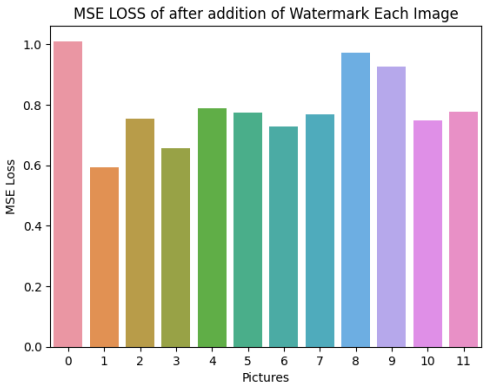

Figure 7. MSE Loss

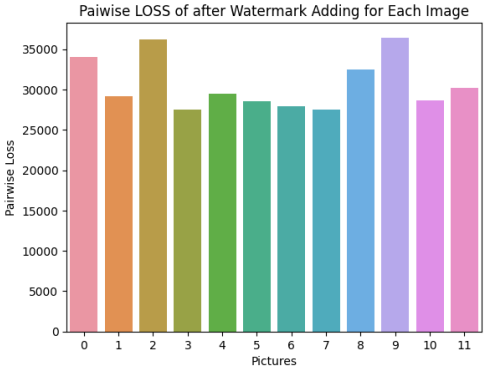

Figure 8. Pairwise Loss

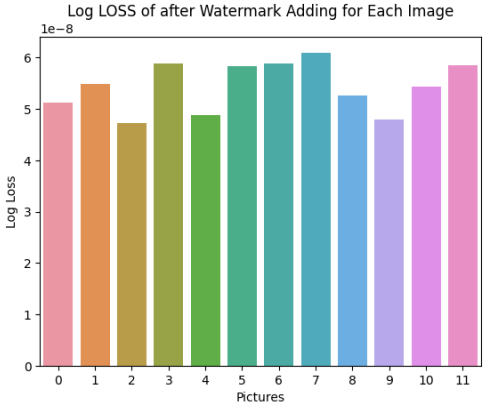

Figure 9. Log Loss

Then Figure 10 is the image showing addition and removal of normal watermark from the images in a row.

And Figure 11,12 are the images showing addition and removal of rotated watermark from the images in a row.

Similarly, output image obtained after text watermarking operation is shown(Figure 15).

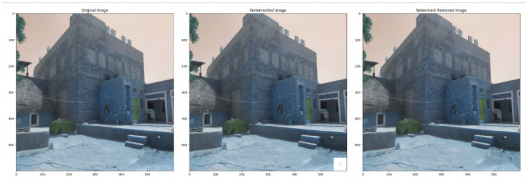

Figure 10. Before and After normal Image watermarking

Figure 11. Result after SIFT Implementation

Figure 12. Result after ORB Implementation

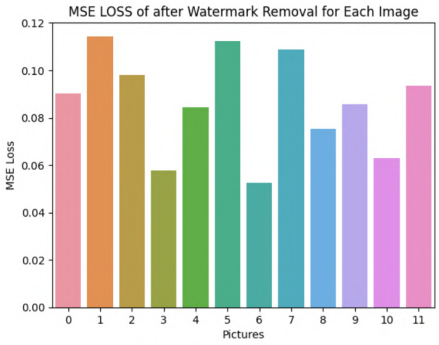

Figure 13. MSE loss using ORB

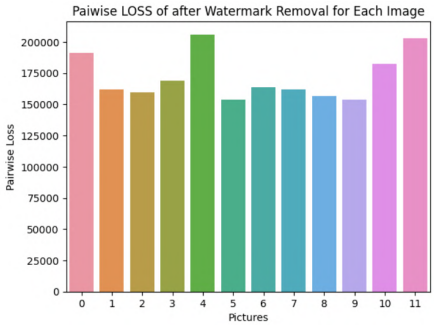

Figure 14. Pairwise loss using ORB

After that Figure 17 is the image obtained after removal of text from watermarked image but is not succeeded well.

Then using different technique, we have achieved good results on text removal. Figure 18 is representing the same.

After this we have applied invisible watermarking on

Figure 15. Text Watermarked Image

Figure 16. Text Watermarked Image

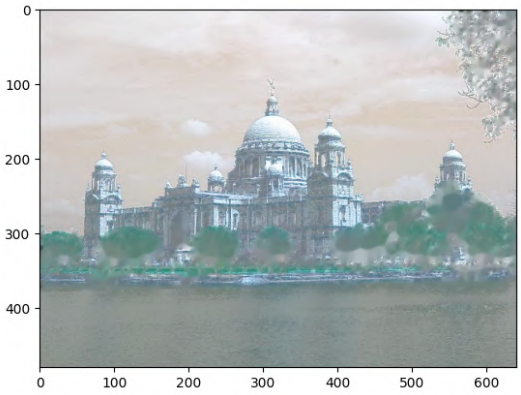

Figure 17. Text Removal(Not giving proper result)

some images, below is the result of invisible watermarking(Figure 19).

Figure 18. Text Removal on Watermarked Image

Figure 19. Watermarked Image after invisible watermarking

7. Conclusion

In conclusion, our project on image watermarking demonstrated different ways of protecting image copyright using visible and invisible watermarking techniques through logos and text on a large dataset of 500+ images. Also, it has showed how can we remove these watermarks from the watermarked images to get back almost original images. At the same time, we have also used metrics to check our performance of watermarking techniques. We have also identified potential flaws or weaknesses in the watermarking process and develop strategies to strengthen image protection. Ultimately, our goal is to contribute to the ongoing efforts to protect intellectual property rights in the digital age and provide insight into the current state of image watermarking technology.

8. Reference

Below is the source where we have taken reference:

1. ChatGPT
2. https://ieeexplore.ieee.org/document/1560462
3. https://docs.opencv.org/4.x/