ENSE 496AE Midterm Report

Watermarking

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Our Original Assignment

Our objective with this assignment was to first take two images named town hall and identify which of the two was watermarked. We were then to take the unwatermarked image and then insert a watermark based on the text given. The text given to us in this case was "The best way to predict the future is to invent it". Next we were supposed to apply different filters to the newly watermarked image, these consisted of cropping, grayscale, high contrast filters and observe and comment on the effects they have on the strength of the watermark. Finally we were supposed to take another image as the cover file, a painting called "Death of Socrates" and insert/embed the watermarked image into it calling it the final image. We were then to take this final image and try to generate back the watermarked image and test to see if the watermark is still present. If it is present, is it the same watermark (text) that was originally inserted? We were to also check the cover image after extraction to see if there is a watermark present.

"Death of Socrates" by French painter Jacques-Louis David from the Metropolitan Museum of Art. (cover file)

Town Hall Image A

Town Hall Image B

Challenges with the Original Assignment

With original images provided we were unable to identify which of the two images were watermarked. In order to identify which of the two images is watermarked OpenStego requires the signature file that was originally used to watermark the file. Since we did not have this file, there was no way to verify which image had the watermark. When using a different signature file

to determine the strength of the images, the strength of both images always returned zero percent.

Another issue we had was that using certain images within OpenStego resulted with errors. Somes images we were unable to watermark so we had to select images within what OpenStego would allow. Examples of the error we were receiving as well as the images that worked and didn't work for us can be seen in the images below.

We were also unable to choose what we watermark the image with. As with the original assignment we were not able to watermark one of the given images with the text since the program doesn't give us the option to select what the image is watermarked with. We did notice however that when creating the signature file for the watermark the larger the text is for the signature, the stronger the watermark is for the image. For our assignment we simply used the text that was given to use as the text for the signature file.

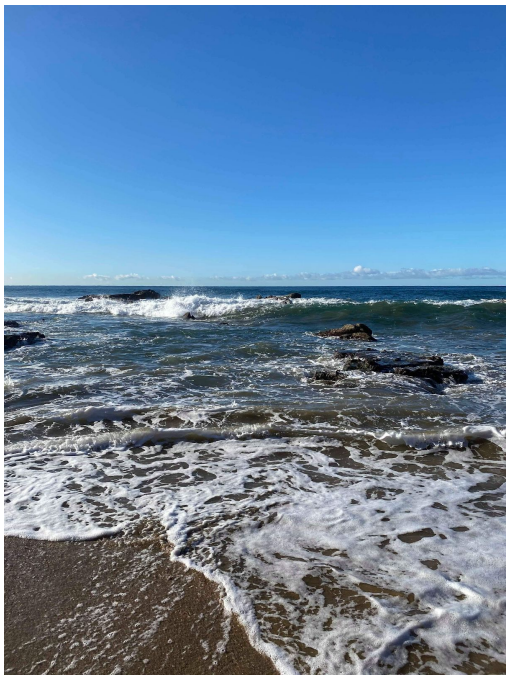
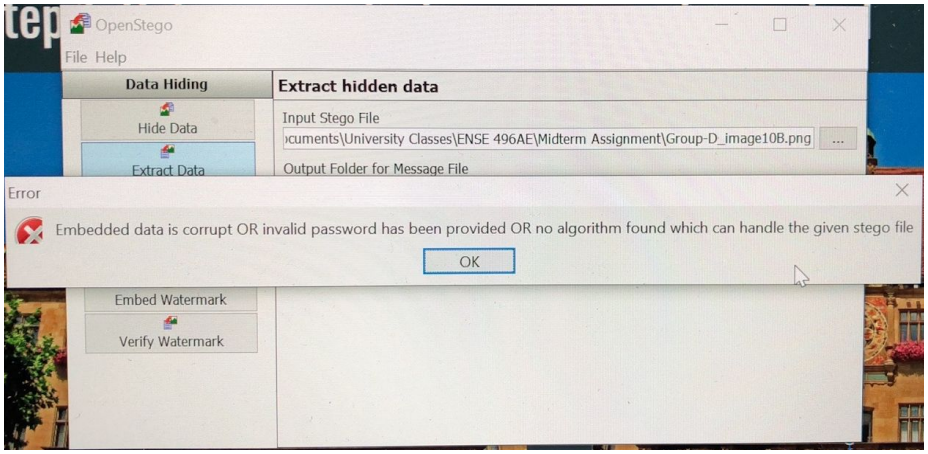
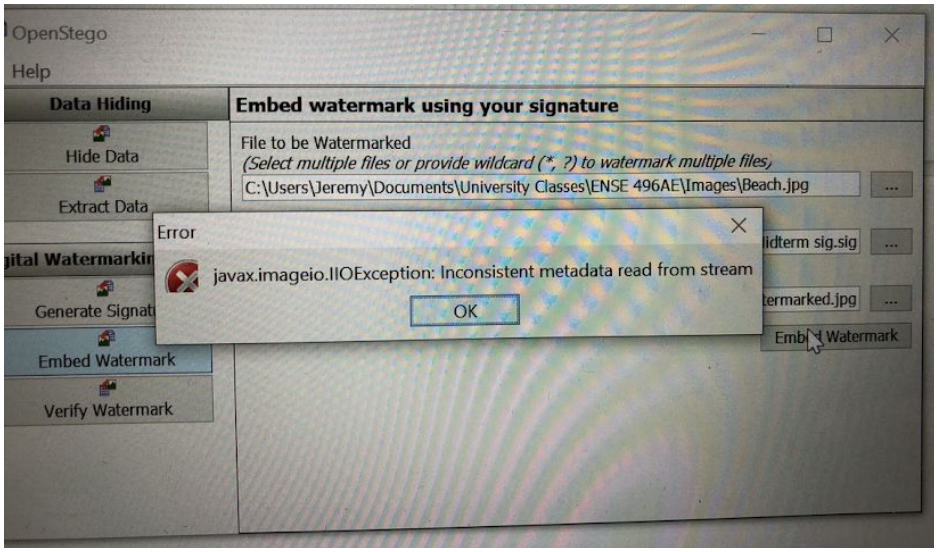


Image that didn't work 1 (beach)

Image that didn't work 2 (sun ring)



No method of extraction for watermarks



Error with embedding the beach Image

Effect of Cropping

We took two watermarked images to check the effect of cropping on them. First file is in the .jpg format(image A) with 705Kb size and the second file is in the .png format(image B) with 23.7Mb size.

Cropping in height:
We followed the pixel by pixel approach to crop the image. The tool used for this purpose is Fotor which is a freeware photo editing tool. Image A is

cropped in height by 1 pixel in the tool, then saved the cropped image. Verified the watermark in the openstego using the same signature file. The strength showed 89% which initially was 100%. Now cropped the image A by 2 pixels and followed the same process above. The strength of the watermark still showed the same as 89%. By cropping 3 pixels, the strength became 0%.

Took the image B, cropped in height by 1 pixel using the same tool Fotor. Saved the image and verified the watermark strength to be 100%. The strength of the watermark did not change until the 3 pixels but it dropped drastically to 0% after 4 pixels were cropped.

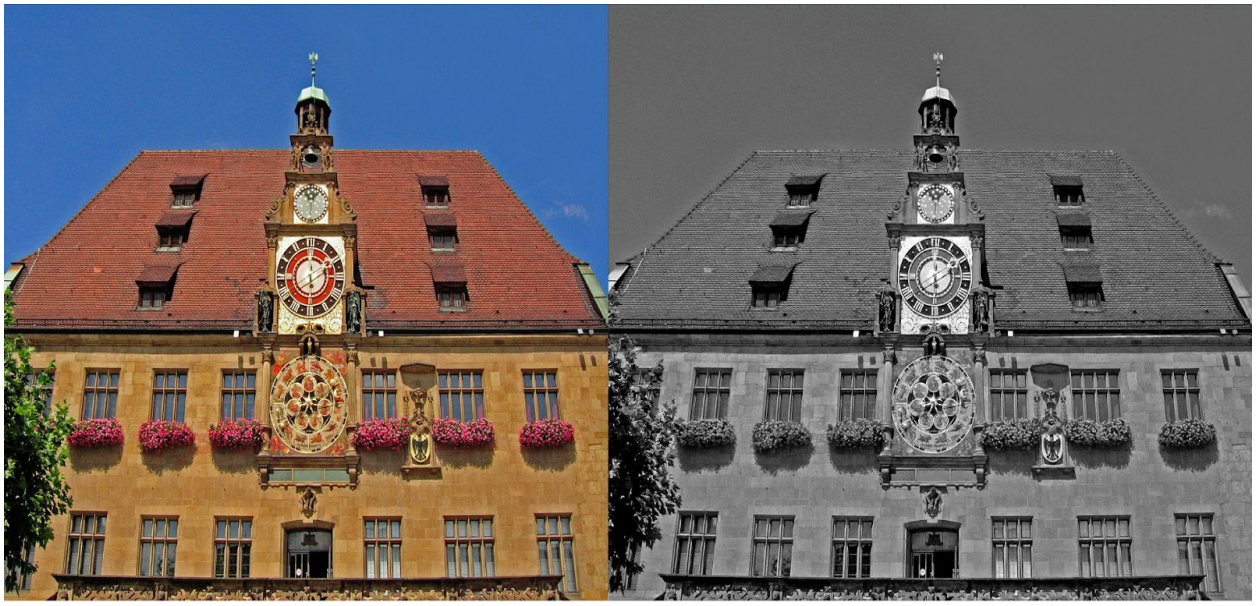
Cropping in width:
Image A is cropped in width by 1 pixel and the strength is 100%. After cropping it by 2 and 3 pixels the strength showed 67% each time. By cropping the image in width by 4, 5, 6 pixels the strength was 33% for each pixel. It degraded to 0% after 9 pixels were cropped.

After cropping the image B by 2 pixels in width the strength remained 100%. The strength falls to 11% after the 3rd pixel was cropped and it became 0% when the 4th pixel was removed.

Effect of Grayscale

We applied the Grayscale filter on the watermarked image using the Fotor tool. For the Grayscale intensity of 50 the strength dropped slightly to 89% and for the intensity of 100, the strength still remained 89%. The intensity of the Grayscale did not alter the strength of the watermark.

We applied a sub filter called ‘Glow Grayscale’ which the tool offered. The strength still remained to be 89%.



Example of applying a Grayscale filter

Effect of Contrast

We tried to check the strength of the watermark by altering the contrast of the image and the results were interesting. Applying the contrast of +50 decreased the strength to 56% and it became 0% when the contrast is +100. So, increase in strength will decrease the strength of the watermark. But there is no change in the strength if the contrast is increased in the negative way i.e., at contrast -100 the strength is 100%.

Effect of other filters

Most of the filters have no effect on the strength of the watermark. We tried with filters like lomo, vintage and retro warm which the tool offered and the strength still remained 100% even after applying these filters. However, the Black and white(B&W) filters changed the strength drastically. After applying the B&W1 filter the strength lowered to 22% and applying the B&W2, B&W3 filters showed the strength 67% each time.

Comparing the strength of a screenshot image

We took a screenshot of a watermarked image and verified its strength. There was no watermark in the screenshot image and the strength showed 0%.

Embedding the watermarked image in a cover file:

The cover file we took for this test is a painting image which is in .jpg format and the size is 955Kb and the watermarked image is in the same format(.jpg) and the size is 780Kb. Using the data hiding option in the openstego, the watermarked image was embedded in the cover file. The final image(final.jpg) was saved and we checked the watermark in this file. The strength was 0% so there was no watermark in the final image.
In the next case, we extracted the watermark image from the final.jpg and verified the strength of the watermarked image. The strength did not change and still showed 100%.

By the above process, we observed that the openstego only supports the embedding when the cover file is larger in size than the message file. It does not accept if the message file is equal in size or larger than the cover file.

Conclusion

Through our research and testing we have found there can be no doubt that watermarking can be a powerful tool in steganography. Signatures used to watermark an image were found to play a role in its corresponding strength. Using a larger signature file was shown to increase the strength of the watermark drastically, while the length of the watermark had no effect. After we had watermark multiple images and tested them with techniques such as cropping, we found that the actual distribution of the watermark was totally random. We found evidence that few filters had effects on the

watermark signature. Most notably was the grayscale filter, as well as altering the contrast of the picture file. When embedding watermarked images into a cover file, it is possible to extract the watermarked image and find the original signature unchanged. But it is not possible to detect the watermark in the cover file. If it were possible to control the watermarking process, the size of the files may be able to be changed. In the end, watermarking is a very complex, but also very powerful, tool in the field of steganography.