Review of latest SOTA image forgery methods

Master Thesis Dissertation

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Abstract

We trained a deep convolutional neural network to classify 12,630 low-resolution pictures from the German Traffic Sign Recognition Benchmark (GTSRB). On the test data, we achieved top-1 and top-3 accuracies of 97.9% and 99.3% The neural network, which has 1,225,803 parameters, consists of 4 convolutional layers, 2 MaxPooling layers, 6 BatchNormalization layers, 5 Dropout layers and a final 43-way softmax.

Contents

1. Introduction

Summary of the task and main goals/contributions/insights of the project. Main introduction[^1] [^1]: Test caption All the deep learning methods and analysis have been deployed using Google's open-source software libraries **Tensorflow & Keras**[1]

2. Literature review and related work

Test citation (Hu 2018) achieving a 2.25% top-five error rate in 2017 at the ILSVRC.

[1] https://www.tensorflow.org/

3. Description of the task and dataset

4. Image preprocessing

4.1 ELA

Error Level Analysis (ELA) is a technique used in digital image forensics to detect potential image forgeries or manipulations. It leverages the inherent characteristics of lossy image compression algorithms, such as JPEG, to highlight regions in an image that may have been tampered with. The core idea behind ELA is to compare the original image with a re-compressed version to detect areas that exhibit significantly different error levels due to alterations.

To explain ELA mathematically, we will use the following notations:

Let I be the original image that we want to analyze. Let compressed I compressed be the re-compressed version of the image I using a lossy compression algorithm, such as JPEG, with a specific compression quality. The ELA process involves the following steps:

Generate ELA Image: To obtain the ELA image, we first perform the following: Save the original image I as a temporary JPEG file using the same compression quality as the desired analysis. Compute the absolute pixel-wise difference between the original image I and the re-compressed version compressed compressed . The resulting ELA image, denoted as E, highlights regions where there were significant changes in pixel values after compression, indicating potential areas of manipulation.

E(x, y) = test

Pixel Value Scaling: The pixel values in the ELA image are then scaled to enhance the visual differences between manipulated and unmanipulated regions. This scaling is typically done using a normalization factor

s to stretch the pixel values across the full intensity range (0 to 255).

E'(x, y) = test

Visualization and Analysis: The final scaled ELA image, denoted as is visually inspected. Areas with significant brightness variations suggest potential forgery or manipulation, as these regions have undergone more changes during the re-compression process compared to the rest of the image. ELA is useful for detecting various types of image manipulations, such as copy-move forgery, where regions from one part of the image are copied and pasted elsewhere, or splicing, where parts of one image are merged into another.

In conclusion, Error Level Analysis (ELA) is a mathematical technique that exploits the characteristics of lossy compression to highlight potential image manipulations. By comparing the original image with a re-compressed version and analyzing the pixel-wise differences, ELA can help identify areas that may have been tampered with, making it a valuable tool in the field of digital image forensics.

5. Methodology

6. Experimental setting

7. Results

8. Analysis

9. Conclusion and future work

Appendix 1

Additional visualizations from exploratory data analysis

Citations

Hu, Jie. 2018. "Crafting GBD-Net for Object Detection." *IEEE Transactions on Pattern Analysis and Machine Intelligence*.