Final Project Report

ManipulationDetector, MATLAB Application to Detect Forgeries in Signs & Billboards.

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Matt Frey & Darshan Shinde,

Department Of Computer Science, University at Albany.

Abstract:

The advent of image editing tools has made it quite common to see manipulated signs, billboards and advertisements in print, media and internet. The presence of numerous tools and plug-ins in image editors like *Adobe Photoshop*© has made aforementioned manipulation easier even for someone not having a technical training in these fields. Apart from ease of creation, the manipulation is often convincing. When text is on a planar surface and imaged under perspective projection, the text undergoes a specific distortion. When text is manipulated, it is unlikely to precisely satisfy this geometric mapping, which can be detected.

Research Technique:

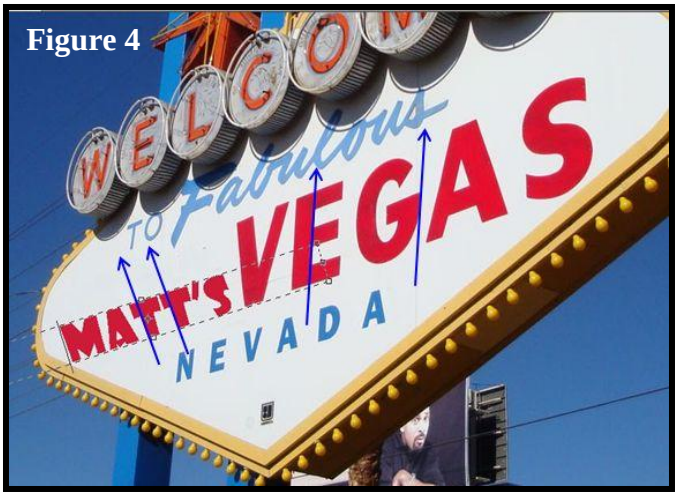
Our program is written using MATLAB, and uses image forensics techniques to determine if images containing text, such as fake writings on a billboard, are authentic or forged. This analyzes variations in perspective projections of the text and font. When text is inserted into an image, the precise rules of perspective projection are violated, and these violations are not perceptually obvious. However, these violations can be detected by comparing the text field for deviations in planar homography and fonts; making it possible to determine if the text was forged. These techniques form the main subject of research paper titled *DETECTING PHOTO MANIPULATION ON SIGNS AND BILLBOARDS* by Valentina Conotter & Hany Farid (2012)[1].

The research paper primarily concentrates on four detection techniques for identifying forged signs and billboards. These are **a.) Planar Homography; b.) Known Fonts; c.) Unknown Fonts & d.) Photo Composite.** Our software primarily concentrates on our adaptation of the conclusions of Planar Homography technique to identify if the board is edited or not. The same conclusions can also be adapted to identify if the fonts in the text are consistent or otherwise.

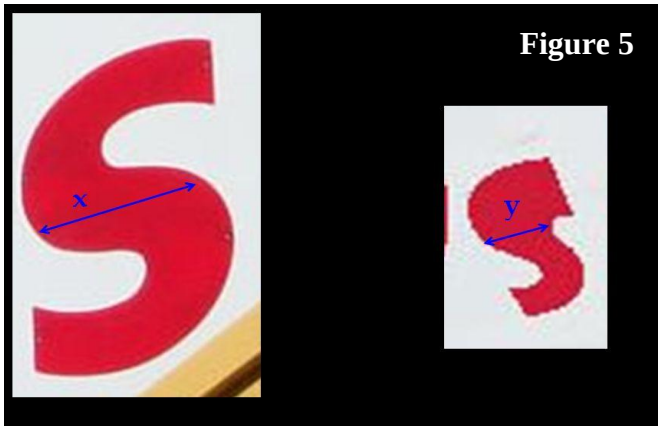
Example of Adapted Techniques:

Our adaptation of Planar Homography primarily concentrates testing the consistency of the plane in which the font is placed after forgery. For consistent and unforged planes, the lines drawn along the edges of the font, which also show the plane of text are usually parallel to each other. This is inconsistent in case of edited text.

In the following example, we see an unedited sign of the famous 'Welcome to fabulous LAS VEGAS' board at entrance of the Casino capital (fig 1.). The edited sign, saying 'MATT'S VEGAS' is seen in fig 2. Figures 3 and 4 show the directions of the planes of the edited, MATT'S text and the original VEGAS sign respectively. Though horizontal straight lines are parallel for both the texts, Vertical lines drawn corresponding to text orientation reveal vertical planes to be different for both the pieces of text, a sign of possible forgery.



The same technique can also be used for detecting the inconsistencies of fonts in the text. As obvious to the curious onlooker, the font of the MATT's appears to be quite different than that of VEGAS. We use the method of measuring the spacing between any two similar points on the fonts to calculate if the fonts are similar or not. From the example above, we see that the distance between two similar points on 'S' in both the words can prove these to be different , as shown in figure 5, where $x \neq y$.



For inclined surfaces (figure 6), the unedited nature of fonts is seen in the size of similar letters ('l' and 'e' in this case), whose size changes with a consistent proportions, which is otherwise in forged text. As seen in the image, the ratios of x/y and x_1/y_1 are consistent for unaltered text.

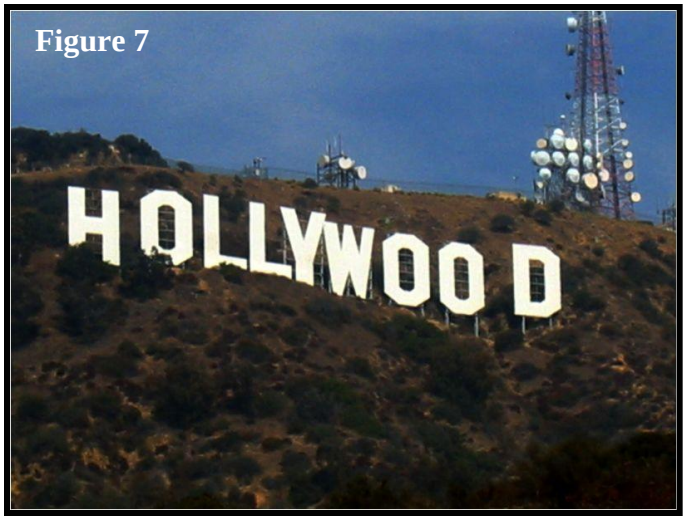
Steps taken by our software:

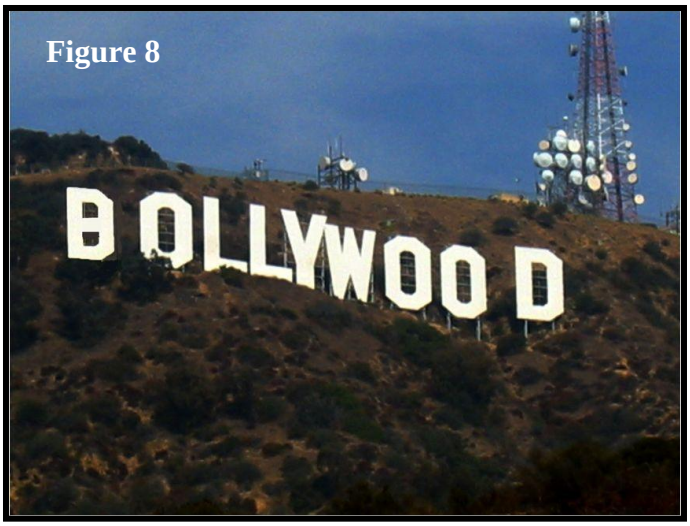
The process starts with a Text Area Selection. The selected text image saved as JPEG for MATLAB parsing. Points selected for linear comparison. In our system, we do this by entering the co-ordinates of the points into our MATLAB Code. The lines are drawn based on point profile. The slopes of these lines can then be compared to determine the homography of the text. For detecting of the font inconsistencies, we mention the two points on the letters along which we want the line to be drawn for finding out the distance. If the distance between two points appears inconsistent/different, one can conclude absence of forgery.

Limitations of our Technique:

Our technique works only if the edited text has been placed in inconsistent projection. It fails to work if individual letters are placed in different planes. As seen in the figures 7 & 8, the famous 'Hollywood' sign at Los Angeles has been altered to 'Bollywood'. Detection of forgery in this case would be difficult given the fact the original 'Hollywood' sign consists of letters which are placed in different planes unlike other examples (Las Vegas) which we considered before.

The consistency of font detection, which is manual in our software (one has to manually select points), becomes ineffective if the fonts that are closely related (i.e. Calibri and Cambria). Furthermore, the results are largely altered if points are not correctly selected.





Conclusions:

Since no forgery is perfect, inconsistencies in alignment and fonts often creep in. With that said, it is quite easy to detect the forgeries in the signs using the mentioned techniques for some evidence remains. A determined forger could circumvent this technique by applying the correct homography to the inserted text. Taking this in account, relevant techniques like CFA interpolation, noise levels, can be considered to detect inconsistencies.

Bibliography:

1.) Conotter, V., Boato, G., & Farid, H. (2010). *'Detecting Photo Manipulation on Signs and Billboards'*, IEEE International Conference on Image Processing, (pp. 1741-1744). Hong Kong.