Foray ADAMS Photoshop Actions for Mitigation of JPG Artifacts

Introduction

Far too often, people use a high compression setting on their digital cameras and flatbed scanners or in the software they use to make images smaller (in size) so they can store more images on their memory cards, download or email their images faster. Unfortunately, what far too many people don't realize is that JPG (also known as JPEG, which is short for "Joint Photographic Experts Group") compression discards actual pixel values. Depending upon the level of JPG compression used, the images can be damaged significantly and the details within the image can lost and the image can become noticeably "blocky" as well as can appear pixilated.

Most JPG compression algorithms are consider to be "lossy" because actual details within the image can be lost. JPG algorithms that lose less detail are "less lossy." Today there are some algorithms that are considered to be "lossless" meaning that no details are lost in the compression process, but color values can be changed within the image, which can affect the image enhancement process.

Lossless compression allows the exact original data to be reconstructed from the compressed data whereas lossy compression actually ***creates*** replacement values for the missing data using the sampled data values saved in the compression process.

Lossless compression is used in many applications, such as email or ZIP files or other applications where deviations from the original source data could be catastrophic, such as executable computer program files, text documents, spreadsheets, etc.

In digital imaging, JPG-LS or JPG 2000 algorithms provide near-lossless compression. JPG 200 and JPG XR are argued to be provided a lossless compression method. The bad news is that JPG-LS, JPG 2000 and JPG XR are not used by camera manufacturers, who have developed their own proprietary compression algorithms. These algorithms are said to be optimized for the quantization of data unique to the imaging sensor in the specific camera. Typically, these algorithms also include an automatic noise reduction process as well as an automatic sharpening process.

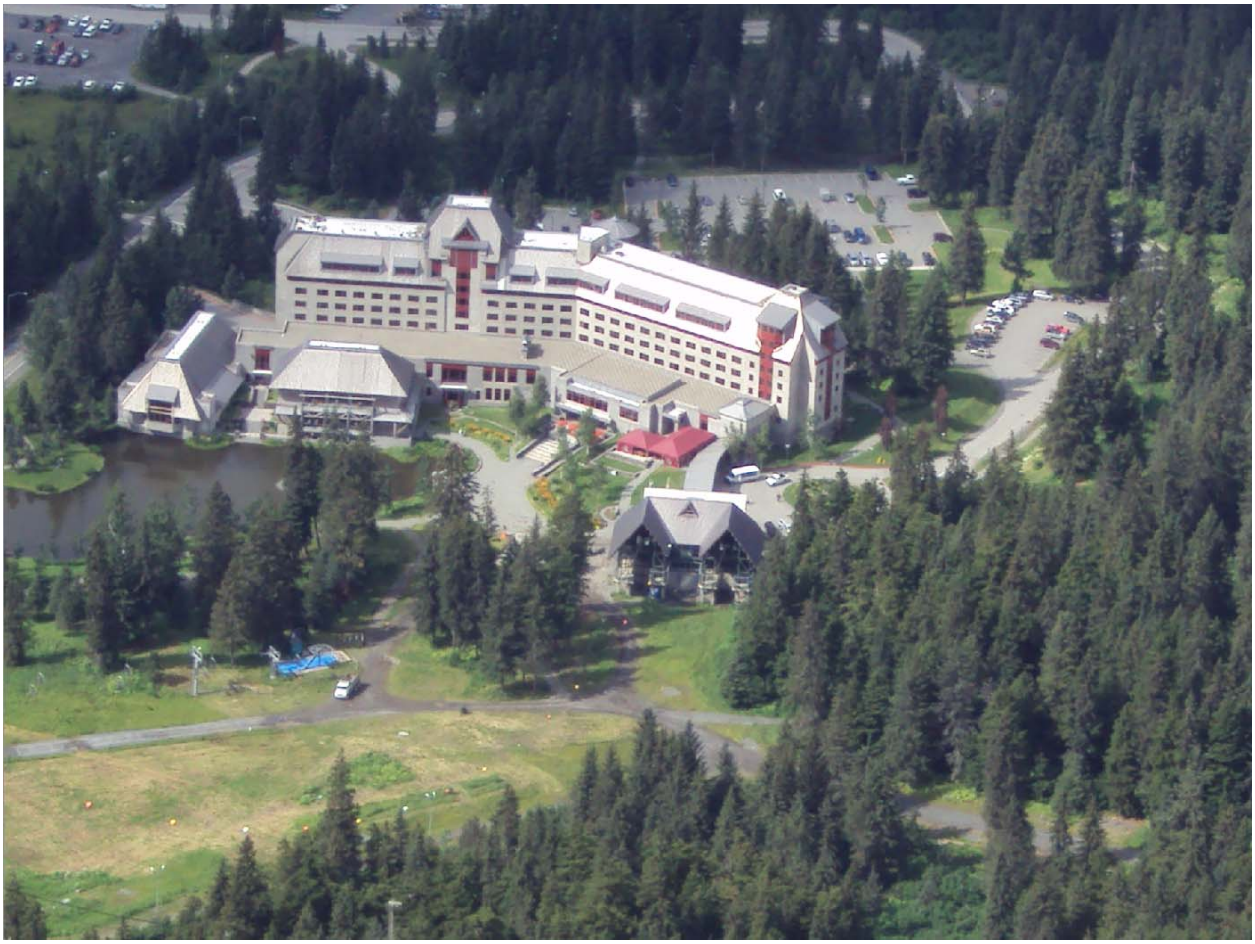
The picture below was captured using a 10 megapixel (MP) digital camera and the image was compressed using the highest quality image setting, which has the least amount of compression. When stored on the memory card in the camera or when saved on the computer, the size of the file on disk is 3,645,440 bytes or 3.47 megabytes (MB). When the file is decompressed (such as in Photoshop), the image size is 28.6 MB.

When the image is zoomed out (reduced) so the entire picture can be displayed on a computer screen. On a 27 inch monitor with a screen resolution of 1920 pixels by 1200 pixels, the image, which contains 3648 pixels wide by 2736 pixels high, is resampled to 38.5% or approximately a ratio of 2.6 pixels values

resampled to provide 1 pixel on the display. The image detail has also been further resampled by inserting the image onto this page, where the width and height of the image is 6.51 inches by 4.87 inches, which is significantly less than half the size that it was displayed on a 27 inch monitor. When displayed on the 27 inch monitor, the image measures 15 inches wide by 11.25 inches high.

And, of course, there is also a significant resampling of pixel values when the image is printed, but we're not going to talk about that here because of all of the variables involved in that particular process, such what type of printer is used (i.e., ink jet printer, laser printer, or dye sublimation printer), what type of paper is used (i.e., plain, matte finish, luster, glossy, etc.), what are the technical specifications of the printer (i.e., 1.5, 2.0, 3.5, 4.0, 6.0 or 9.0 picoliter droplets or toner), so on and so forth. In other words, the printing process can hide a significant number of flaws in poor quality, low resolution jpg images … and there are a lot of people "banking" on the fact that you can't easily see the loss of detail when the image is printed. Unfortunate for them, the loss can be enormously apparent when the image is viewed on a computer monitor.

I know that all of these numbers of pixels, percentages, inches and droplet sizes sound painful and may provide more than enough stimulation required for the onset of a migraine headache, so let's just simply suffice it to say that the loss of detail may not be noticeable when the entire image is printed or reduced for display on a monitor, but it can (will be) significantly noticeable when the image is zoomed (enlarged), especially during image processing, analysis and comparison.



In the event that you would need to zoom in on the image to conduct an analysis of the details in the image, the loss of detail may become significantly noticeable (visible). In fact, it may prevent meaningful analysis of the details within the image and render it useless for analysis. This is particularly true when dealing with images used for forensic analysis, such as footwear, bloodstain pattern analysis, so on and so forth.

For example, in the picture above, what do you think the orange, yellow and white blips are in the lower left corner of the image? (There are actually a series of orange, yellow and white blips just to the left and above the tree tops in the lower portion of the image.) Believe it or not, those are actually people who were walking from a parking area off the left side of the picture to the aerial tram. Notice the relative size of the people, when viewed from above – albeit at an angle, compared to the size of the white truck at the road junction to the right of the blue tarp. And, depending upon whether you are reading this in a printed form or if you are reading it in an electronic form on a computer monitor, you may or may not even be able to see the people blips.

JPG Artifacts

Most, if not all JPG algorithms are based on a standard 8 pixel by 8 pixel block in which a Fourier-related transform is used. Depending upon the frequency components of the values in that block, several types of artifacts can appear including, but not limited to:

- Ringing (artifacts caused when there are sharp transitions within the block, which is particularly visible around text in pictures)
- Posterizing (artifacts caused when portions of the original image with a gradual transition are replaced by abrupt changes in shading and gradation from one area of tone to another)
- Staircase noise (aliasing) along curving edges
- Blockiness (also called checkerboarding)

All of these artifacts appear in the image on the next page.

Argumentatively, some people will still use a compressed image for latent print, footwear, tire tread or Questioned Document analysis because they can still see enough detail when the image is zoomed out (and visible detail within the image is reduced) even though there are portions of the image that are unusable and certain characteristics within the image cannot be determined. (Is it an ending ridge or is it a bifurcation? Only the original image detail knows.) Admittedly in some "simple" (non-complex) images, you may be able to get by using a ***high-quality*** JPG image.

Artifact Reduction

Over the years, various techniques and processes have been suggested to reduce the effects of image compression so that people (in our case the law enforcement agencies) retain the benefits of compression (such as lower transmission requirements and reduced storage costs). To date, there has been no "post-processing" technique that has been demonstrated to improve image quality in all images. As a result, none of the techniques or processes has gained wide acceptance in law enforcement, particularly in the forensic science community.

While it is impossible to repair the actual damage done to the image during the compression process, you can – at least – make the damage "appear" less distracting.

To help maximize the quality of compressed images as well as automate the process, Foray has developed a new plugin (aka "Action") for Adobe® Photoshop® entitled JPG Artifact Mitigation. This action set includes two separate actions:

- Minimize Major Blocking Artifacts; and
- Minimize Minor Blocking Artifacts

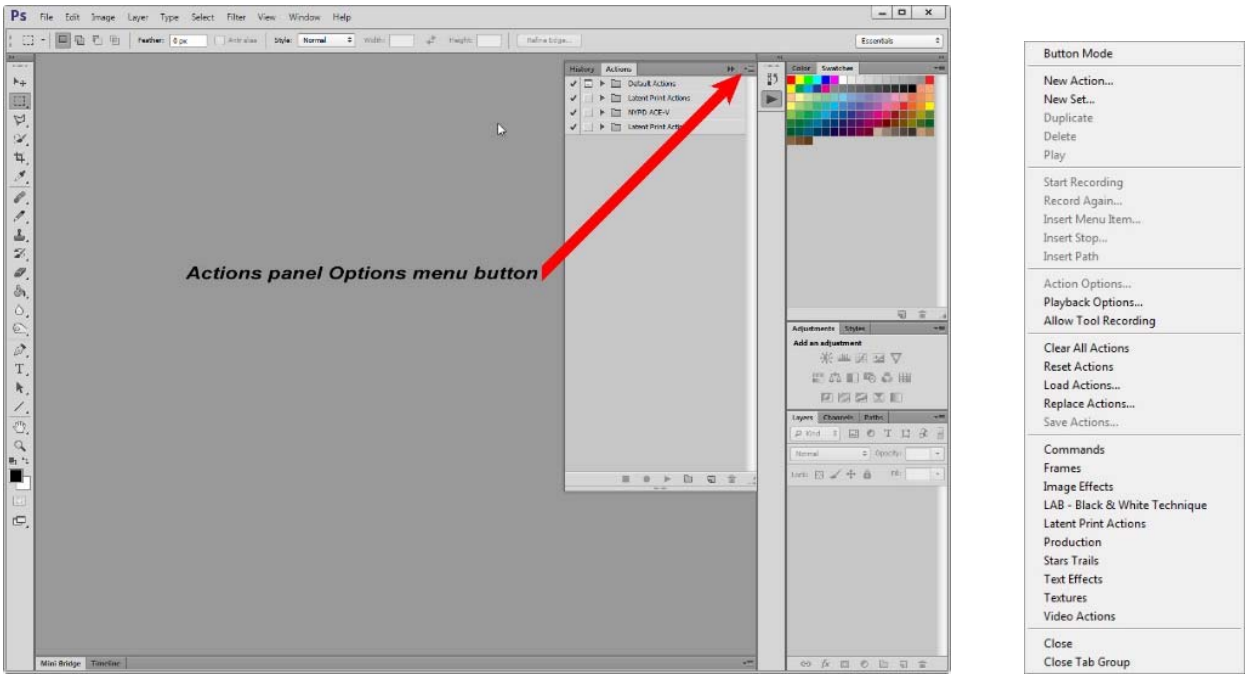
NOTE: This set of actions can be used with Adobe Photoshop CS4/CS5/CS6/CC.

Loading the Photoshop Actions

1. First, start Adobe Photoshop.

2. From the ***Window*** menu option, select ***Actions***. (***NOTE:*** If a checkmark appears to the left of the Actions option, the Actions panel should already be displayed on the right side of the Photoshop window and you will need to locate that panel now.)

3. Click on the ***Actions'*** *Options* menu in the upper right corner of the ***Actions*** panel as shown below. The list of ***Action*** options will be displayed, which is also shown below.



4. From the list of options provided, select ***Load Actions…***. A Navigation window (***Load*** dialog box) will appear on your screen.

5. Navigate to the location where you stored the downloaded *JPG ARTIFACT MITIGATION.ATN* file, then double-click on the file name or click once on the file name and then clicking the ***Load*** button in the ***Load*** dialog box. After the ***Load*** dialog box closes, the new actions will be displayed in the ***Actions*** panel.

You are now ready to start using JPG Artifact Mitigation tools to automate your imaging process.

NOTE: The following pages illustrate two images, the first image (pages 7 - 10) has significant (major) blocking artifacts that are clearly visible – even if you are viewing a printed copy of this document. While there is not too much difference between the end results of the Minimize Major Blocking Artifacts and the Minimize Minimal Blocking Artifacts, there is still some pixilation that is more noticeable in the image processed using the Minimize Minimal Blocking Artifacts as shown on page 10.

In the second set of images (pages 11 – 15), there is minimal blocking in the image. In this original, the blocking artifacts are not that significant and are not readily noticeable until you zoom in to look at the image in more detail or unless you want to print the image as an 8 x 10 inch print.

When an image has minimal artifacts, it is possible to "over correct" the image as shown on pages 12 and 14. The image appearing on page 15 shows a before and after of the image. Again, the original image is not necessarily that bad, but the "processed" image does not contain any of the blocking artifacts, and the contrast of the image has also been improved.

Original Image

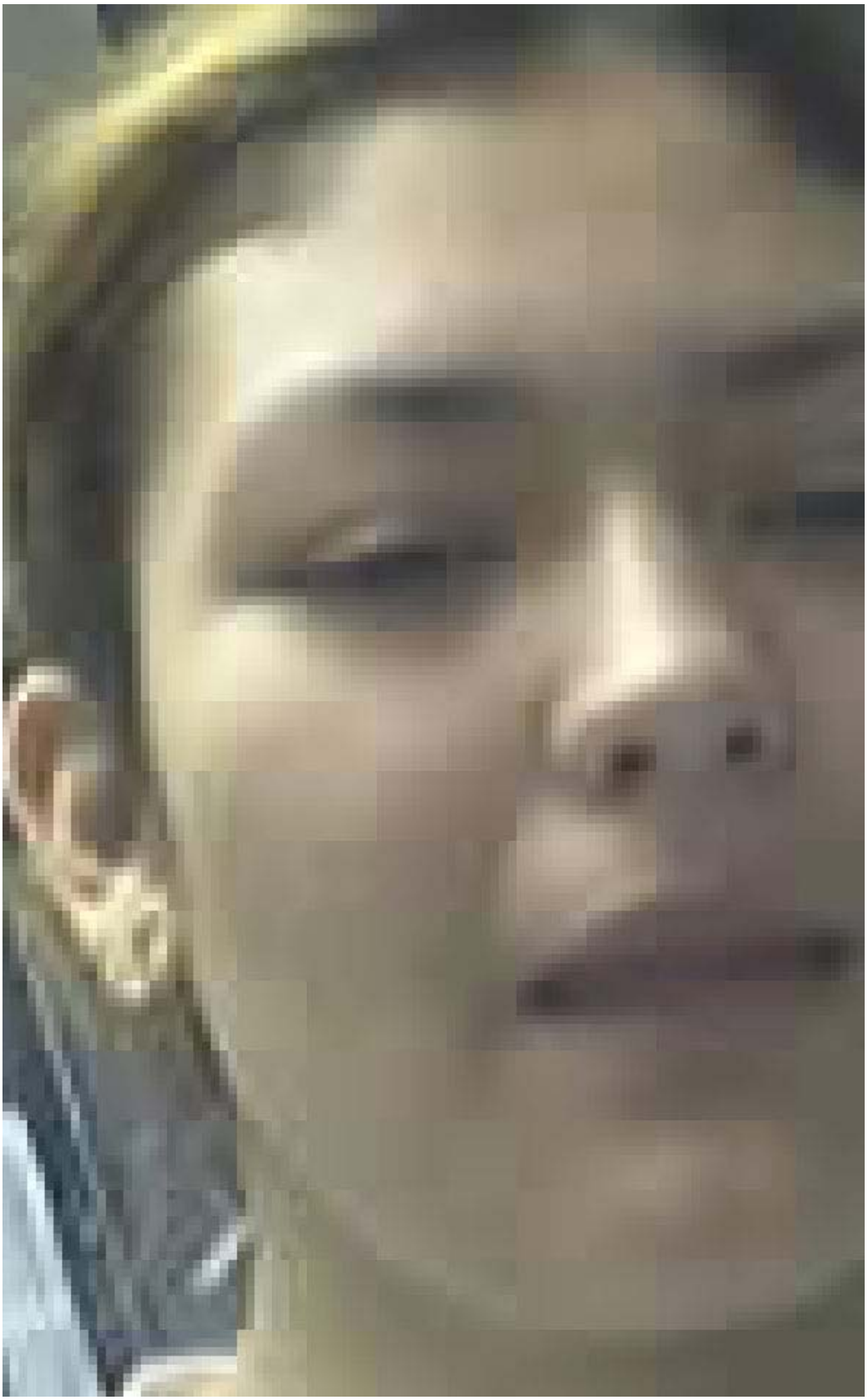


Image after using Minimize Major Blocking Artifacts action

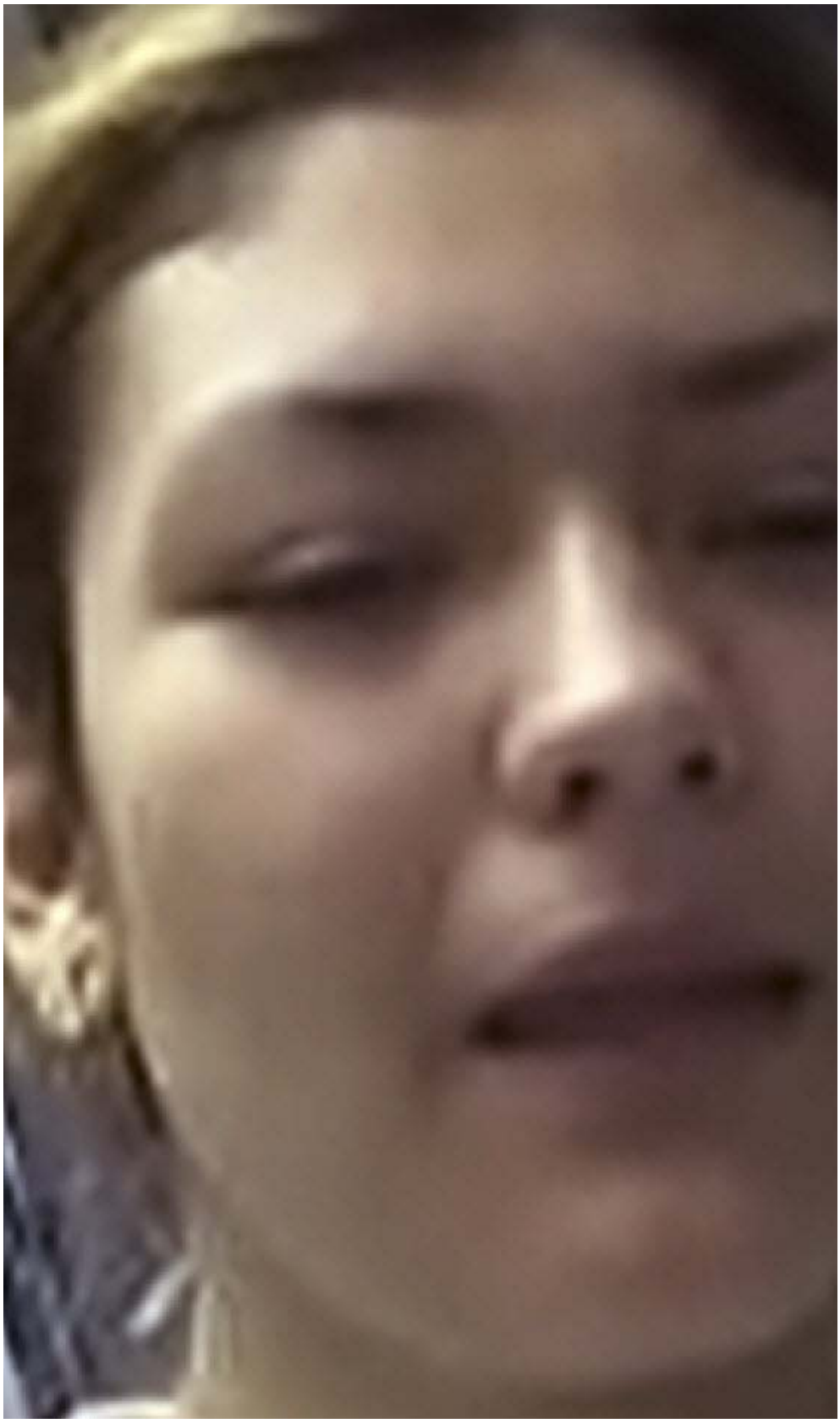
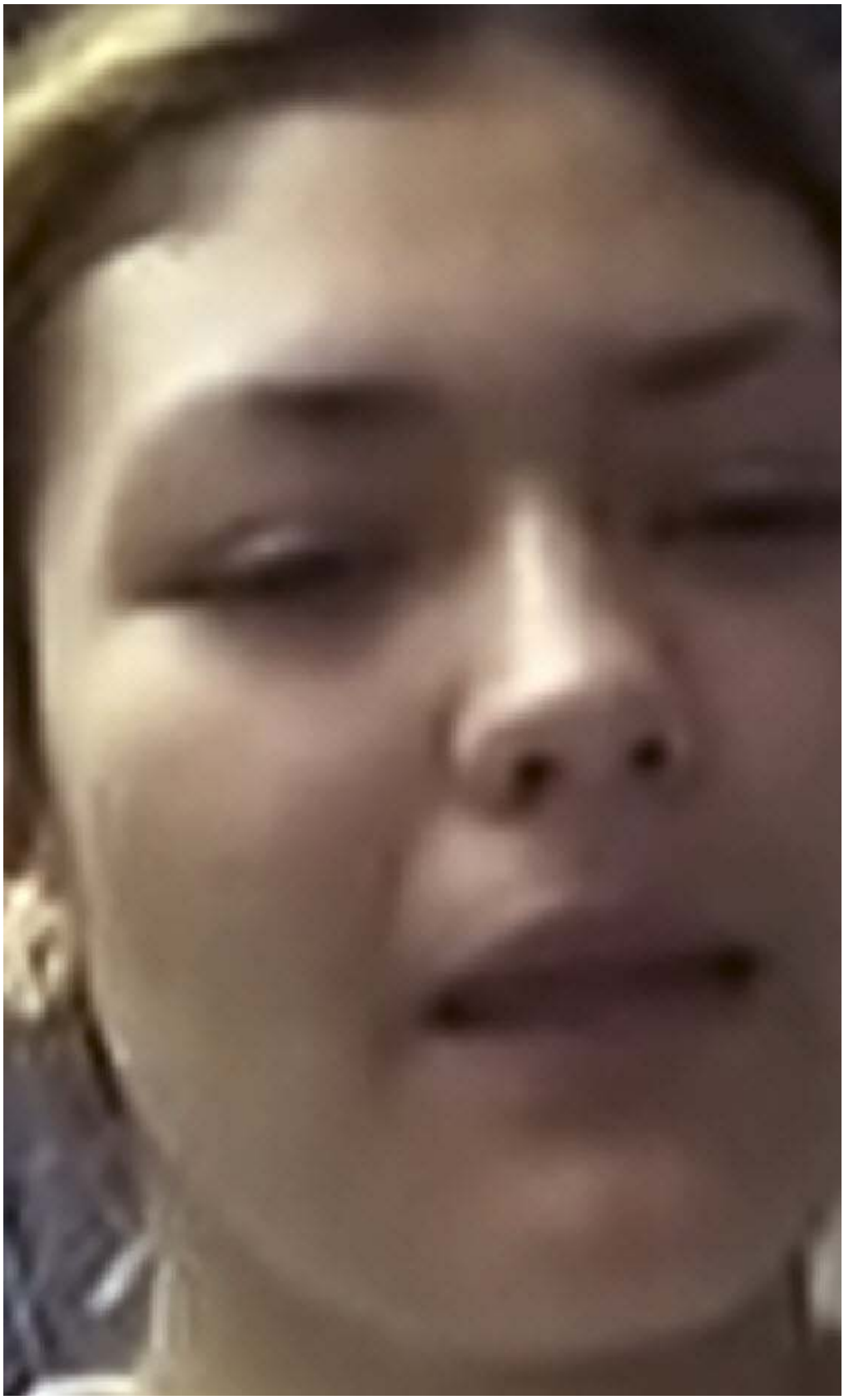


Image after using Minimize Minimal Blocking Artifacts action



Close up of image after using Minimize Major Blocking Artifacts action

Close up of image after using Minimize Minimal Blocking Artifacts action

Original Image

Image after using Minimize Major Blocking Artifacts action

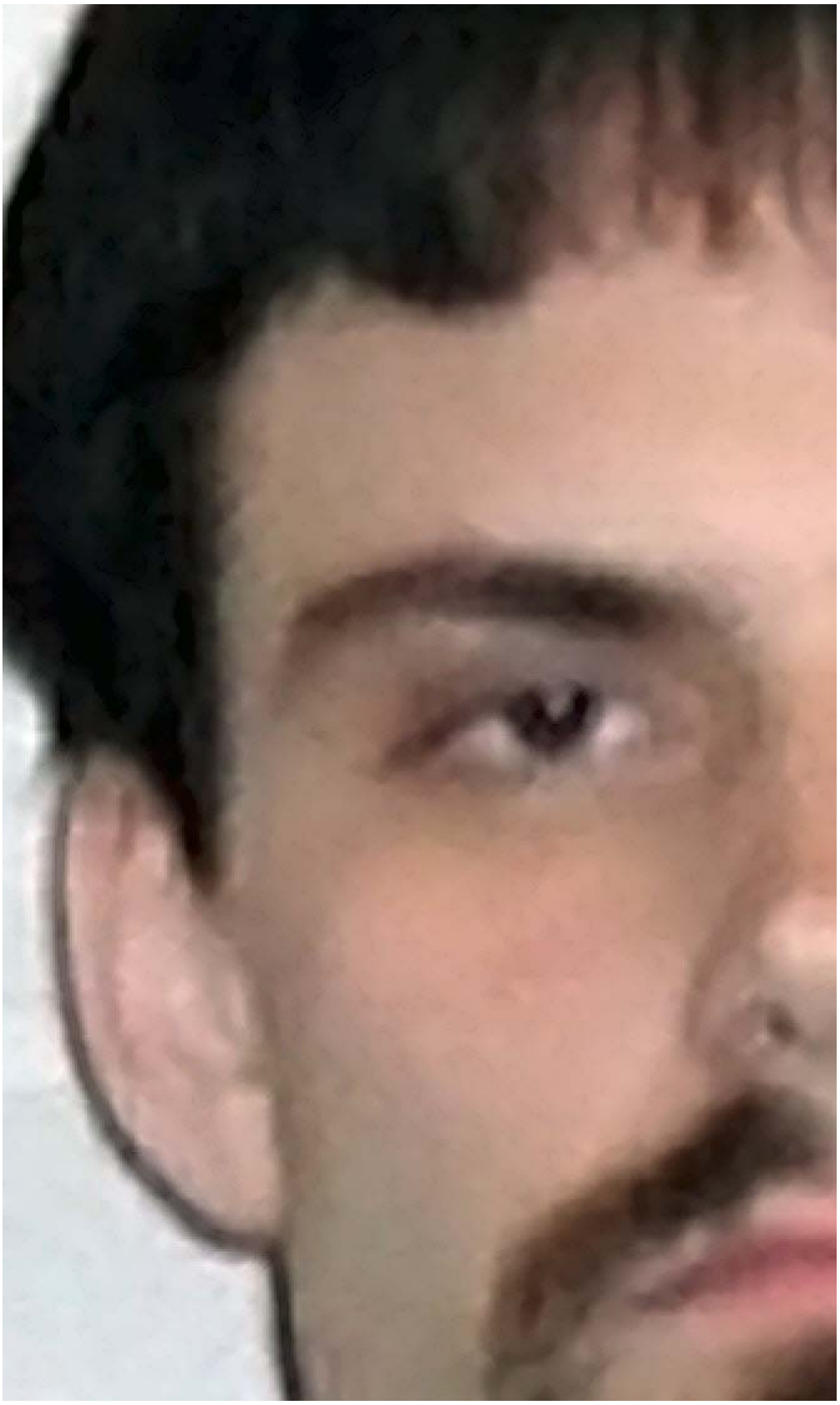
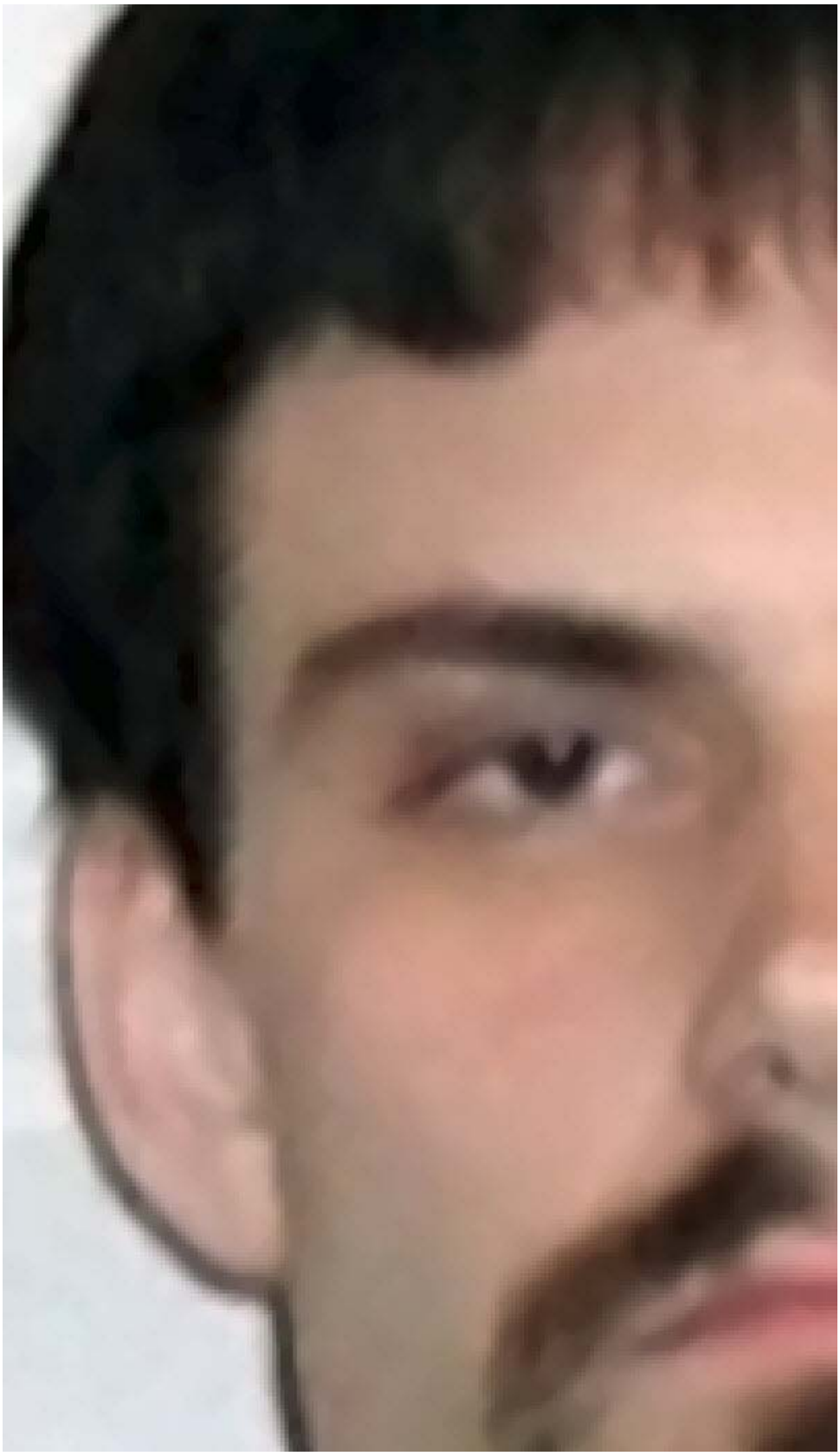
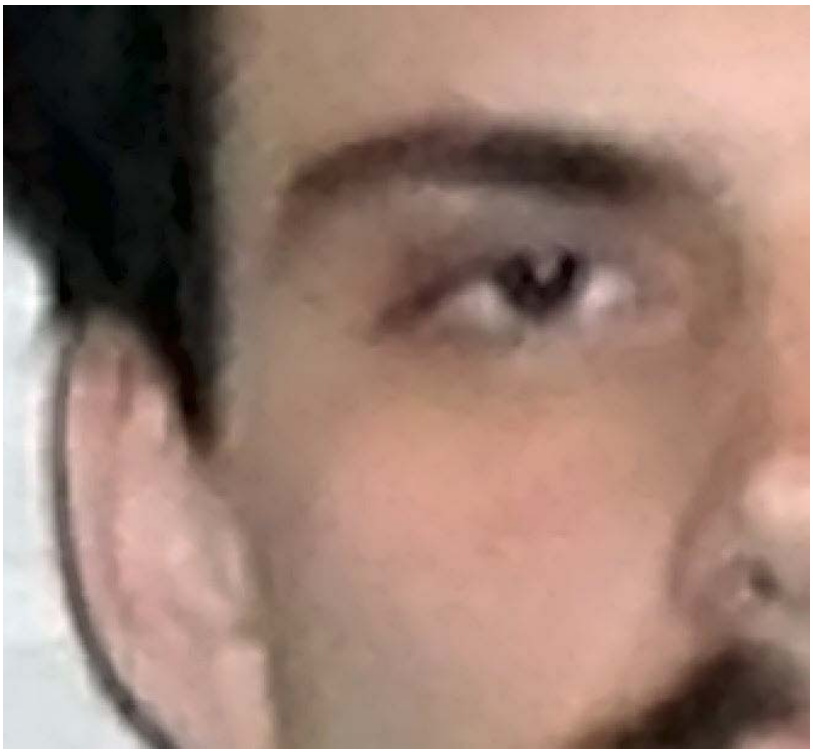


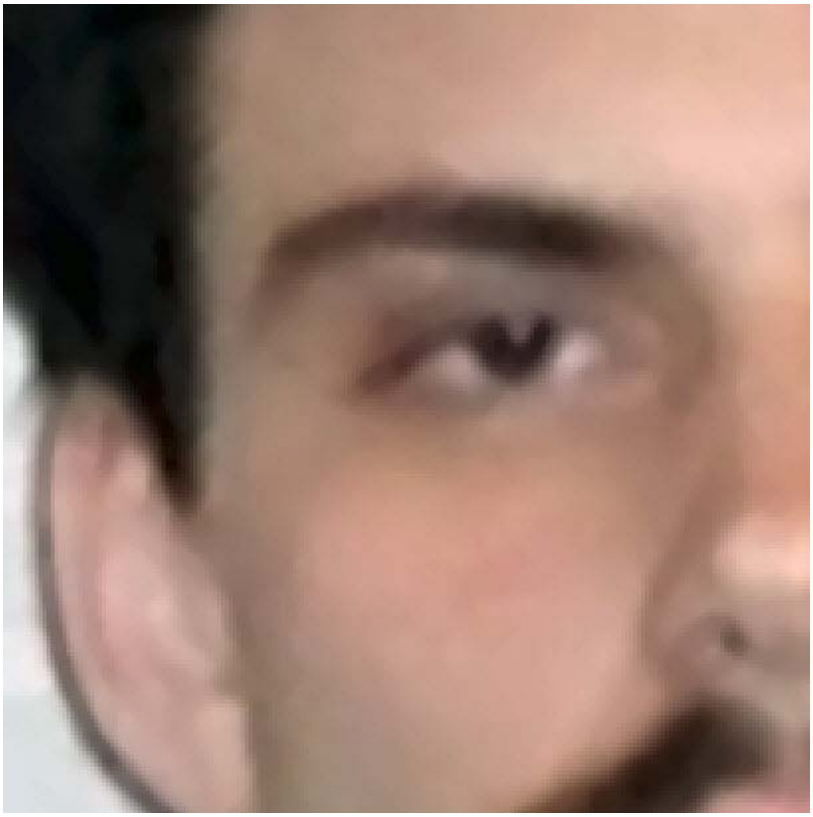
Image after using Minimize Minimal Blocking Artifacts action

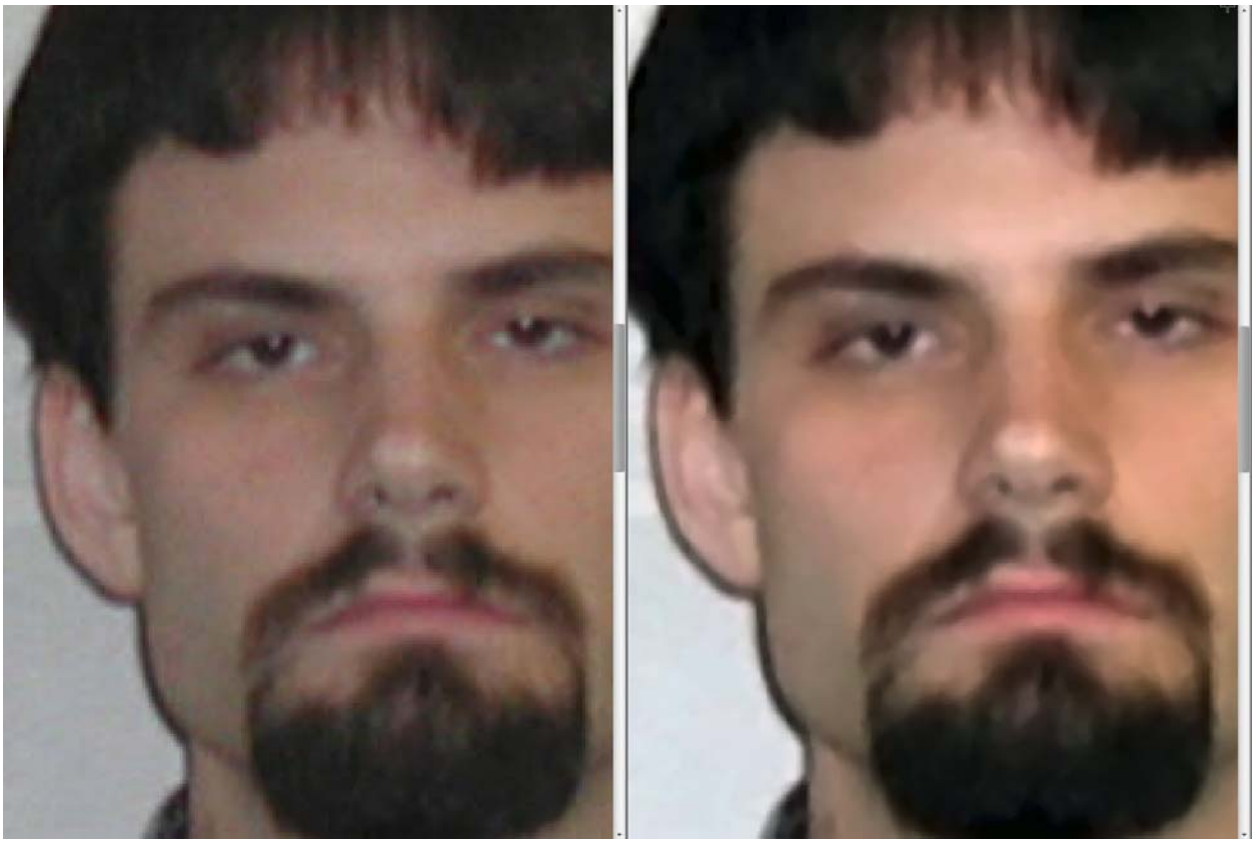


Close up of image after using Minimize Major Blocking Artifacts action



Close up of image after using Minimize Minimal Blocking Artifacts action





While these actions have undergone a series of tests with a wide variety of images, I have not been able to test them under every possible scenario. These actions are provided as a courtesy by Foray Technologies. In return, we simply ask for your feedback. Also, if you encounter any JPG images that are not improved with these actions, we would also be interested in receiving a copy of that image for additional testing to see if we can improve the quality of the actions and/or create a new action(s) to deal with those types of images.

As always, please do not hesitate to let me know if you have any questions or comments. I am looking forward to your feedback. Good luck!

Sincerely,

David Menor Witzke ("Ski")
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Vice President, Program Management
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