VCS PROJECT PROPOSAL

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Denoising in low-light photography

Digital cameras are no magical devices that can instantly take award winning images with a simple click. From the raw data that the sensor can collect, some elaborations are required to make the data appealing to the human eye. When a sensor collects light, or photons, those are converted to an electrical signal and amplified to a higher level. Then through an Analog to Digital converter ADC, converted in digital binary signal and some digital processing is started. The images will be debayered in case of colored photos and the colors balanced compared to the white tones. In some cameras a partial noise suppression algorithm is also performed to improve a little the quality of the image. After that an image can already be displayed without adding more beauty post processing. In situations where there isn't enough information coming to the sensor like low light conditions, the final result can not come to expectation, appearing an image castellated in noise. This noise comes from random photons hitting the sensor from the background, from thermal radiation, from electromagnetic radiation, and from the high level of amplification in situations where the image can appear too dark. Many tricks to improve the signal to noise ratio have been experimented to extract the most possible information from the mess of the raw data but it still remains challenging to get good results when there isn't enough information coming to the sensor.

With the success of AI in different fields, more people are starting to analyze this problem from another completely different point of view. There are already some commercial uses of AI in denoising images, and Topaz Denoise AI distinguishes itself from all other deep learning powered softwares by demonstrating to achieve especially amazing results in denoising any type of photos.

Our data will come from different online repositories. We will accurately study how the noise affects the images, like banding, hot pixels, thermal and electromagnetic noise, chroma and luminance noise, and will artificially generate a big set of images with various of those types of disturbances.
The Topaz company didn't release much information publicly [1], as they call it "black box with millions of filters". Our final objective is to understand how this trained model works and try to reproduce similar results. We will follow the same approach of automated supervised training with two NN. The denoise one will have a big number of filters and given a dirty image will try to denoise it. The supervisor NN will have the job to try to distinguish from two input images which one is the denoised dirty image one and which one is the clean original one. This approach will heavily penalize the learning denoiser when some of the details will be lost.

[1] https://topazlabs.com/learn/understanding-ai-powered-noise-reduction/