Cloud-based RAW Image Editing

Ryan Collins
Department of Computer Science, Durham University

Introduction

This poster describes the
design and implementation of a Cloud-based system for processing and editing RAW images. Previous RAW image editing software is designed for native use, and most of the current software available is proprietary. This paper shows the design and implementation of a system that's not proprietary, and allows for editing of RAW images through our Cloud-based RAW image editing service.

RAW Images Explained

RAW isn't a file format in itself, but rather an umbrella term for a set of many different formats that store the raw camera sensor data. There are a set of different proprietary file formats, that all store similar information, but in different ways. When an image is captured, the camera sensor uses charge
buildup to represent the amount of light that is incident on the sensor (using a phenomenon known as the photoelectric effect). Colour data itself isn't stored at all in the RAW image. Colour is achieved by putting a filter over the sensor, such that each individual part of the sensor captures only red, green or blue light, which then allows one to build up a full colour image. The process of creating a full colour image from the camera sensor is called demosaicing. There are several different steps to decoding RAW
images, in addition to demosaicing which was explained above. These are:

- **White Balance**
- **Gamma Correction** Cameras typically represent colour changes linearly, with a gamma of 1.0. However, this isn't necessarily pleasing to the eye, so this can be changed to change how tones are reflected. This can be used to simulate the tonal output of film cameras, for example.
- **Sharpening/Noise Reduction** Sometimes, noise can creep into the image, particularly if the image itself is shot with large ISO levels (ISO is a sensitivity setting that can be set when taking a photo, to allow the camera sensor to be more sensitive to light). This can be corrected during the editing process. Also, sometimes edges might need to
be enhanced to bring out the detail in the image. This can again be used for stylistic purposes, but this is ultimately the decision of the image editor.

Test of Exposure Adjustment

Figure: Test of Exposure Adjustment (a) Exposure Level Small: 0.0001 (b) Exposure normal: 1.0 (c) Exposure level high: 5000

Test of Colour Adjustment

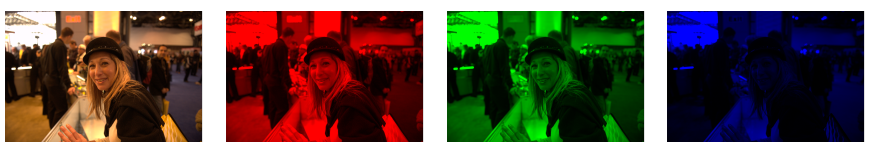


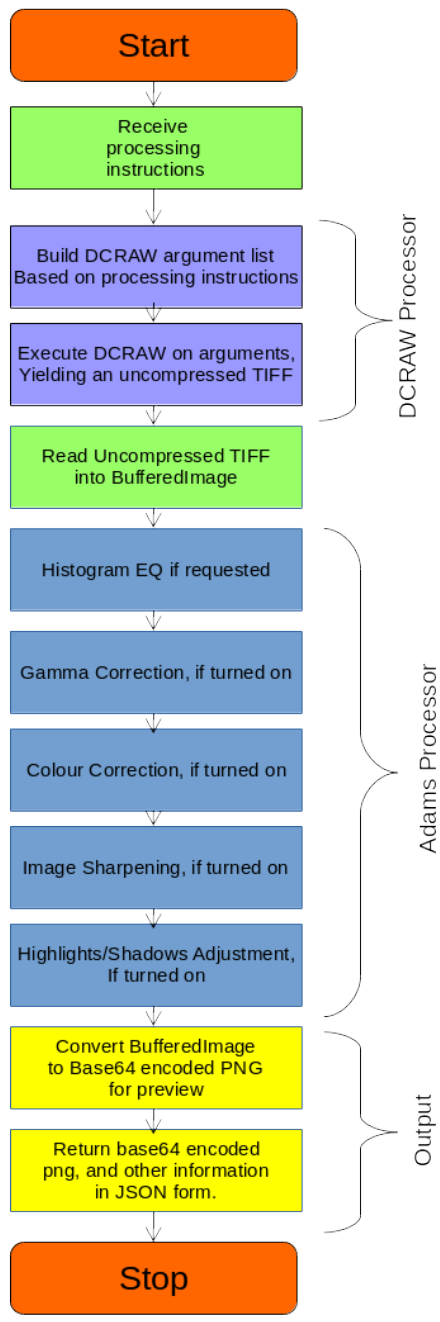
Figure: Test of Colour Balance (a) No Adjustment (b) Red only (green and blue zero) (c) Green only (red and blue zero) (d) Blue only (red and green zero)

To test the functionality of colour adjustment,
we can compare the output of only one channel. If the outcome is only the specified channel, then the colour balance component of the system works.

Test of Gamma Correction

Figure: Test of Gamma Correction output. (a) $\gamma = \mathbf{0.3}$ (b) $\gamma = \mathbf{1.0}$ (c) $\gamma = \mathbf{1.7}$

Overall System Workflow



System Workflow Explained

The system shall receive a set of instructions,
encoded using the JavaScript Object Notation (JSON). These instructions outline what RAW image to use, along with the settings to use for rendering. Due to the proprietary nature of RAW files, rolling our own RAW processing engine is not advisable, as each camera manufacturer has a different file format, and there isn't really an agreed on standard. While one could use Adobe's standard DNG, converters to DNG only exist for Windows and Mac, not Linux (which various Cloud systems might rely on). Therefore, an executable called Dcraw (which is a self-contained C file containing no dependencies) is used to preprocess the RAW image into an uncompressed TIFF image, which is readable by many programming languages as an image file. While Dcraw isn't directly portable, as the executable doesn't require any external dependencies, it massively simplifies the build process, and providing a C compiler exists for some platform, building of this executable can be done automatically (or the external executable can be alternatively obtained from a package manager).