

Algorithms for improving image processing in mobile photography *

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1 Introduction

Today slightly every smartphone has a camera. It is very convenient, until we speak of quality of photos, captured with phone. By this article I will suggest way to improve quality by some algorithms and methods for post-processing that can be included to camera app. I choose this topic because as photograph myself, I was always unpleasant by my photos taken by phone. It maybe arranges for some people, but after seeing photos taken on beginner-class camera I struggled on insufficient quality of taken images. So, this article would add some possible solutions to the problem of poor dynamic range of photos taken with mobile devices nowadays.

2 What are possible solutions?

How can we solve problem with bad quality of photos? There are two ways: by improving hardware or improving software. But why just don't install large sensors (with big pixels in it) from the cameras to the smartphones, making a huge hardware improvement?

It all because of dimensions of the smartphones. Today it's no way that big sensors can be handled in smartphone, which width is mostly limited to 10mm. If you know how camera work, you maybe recently understand the reason why it so, and it is not the size of sensor, but the size of the lens. The sensor is not a solar panel-like device whose size determines how much light you collect. The sensor is behind the lens and in fact, the lens is the determining factor. A large diameter lens captures a lot of light. It almost doesn't matter how large the sensor is. And by installing large sensor at once we should install lens with huge focal length. This is the main issue for relatively thin smartphone.

img of camera structure

In simple words, larger sensor (with big pixels in it) will require larger optics in

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terms of aperture and focal length. This means that the body of the phone will need to be thicker in order to provide the required distance between the lens and the sensor.

So if we can not just increase the sensors size, we need to go in another way, namely improve software. The biggest problem is lack of tones and colors, or in other words, lack of dynamic range. Especially in high-contrast photos. To understand what dynamic range is, we can imagine it as a piano keyboard. There is a range of tones, in which we can see like piano has keyboard with limited width, through which we can play. And the wider it is, the better. Even human eye can not see all range at once, but sensors with big pixels in digital cameras can because of manual exposure, so we can put exposure exactly where we want it to be. Only the biggest and most expensive sensors can accommodate all 12 stops (there is a 12-stop difference in the highlights and shadows). But we are talking about matrices with small pixels, by which we want to cover all range of tones.

The simplest decision is to combine few under- and over-exposed photo into one frame. Doing that we create HDR photo.

Figure 1: Combining few photos with different exposures usually creates HDR image

3 Is HDR photos will solve the problem?

Yes, it would make dynamic range wider. But like every technology it has some problems.

Main problem is ... Firstly lets see some explanation (expl. 3.1), and then one more (expl. 3.2) to fully understand... ¹

3.1 Explanation

Niekedy treba uviesť zoznam:

- Dynamic range is the range between the maximum and minimum measurable light intensities.

3.2 Explanation

How are made under/over-exposed images

- Over- and under-exposed images are made by decreasing or respectively increasing shutter-speed in camera.

¹Niekedy môžete potrebovať aj poznámku pod čiarou.

4 Dôležitá časť

5 Ešte dôležitejšia časť

6 Záver

References

<https://dl.acm.org/doi/10.5555/2383847.2383888>