

Analysis of mobile phone camera performance estimation method

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Abstract-As the forefront of mobile communications, mobile phone industry broad market prospect attracts more and more enterprises to enter this field. With the rapid improvement of the industry, mobiles develop from original feature phone to smart phones, which can take pictures, catch video, access Internet and so on. Meanwhile, performance of camera also becomes the focus of people's attention.

This paper analyzes the performance of the camera objective and subjective evaluation methods, and raises the appropriate test standards. Finally, it suggests a comprehensive evaluation of subjective and objective scoring method, hope can be promoted.

Keywords- phone camera, performance, objectively test, subjective test

I.PREFACE

In the past 20 years, as one of the world's fastest growing industries, communication also becomes a major force in promoting global economic growth. As one of the fixed-line telephone extension, feature phone (features and applications are fixed) can meet the basic requirements of communication. At the end of the last century, digital camera came into people live, from 300,000-pixel, 1.3M pixels to 200 million, more than 3 million pixels.

With the improvement of people life and the development of science, mobile phone also becomes the major means of people's communication, not only making telephone call, sending messages, taking photos, but also playing a more and more important role in our daily life. So smart phone, PDA (Personal Digital Assistant) rises at the moment, and becomes the world's most rapidly development of all the communication products. It can get weather information, stock consulting, and news so easily; meanwhile it has powerful photos function, GPS navigation for people traveling, WIFI wireless to access Internet and so on. Its development embodies the embedded technology in communication industry, the integration of the embedded operating

system, embedded communication, embedded data management system and wireless network technology, so it becomes typical product in IT age. Along with the science and technology rapid progress and development, mobile phone equipment hardware improved in a large extent, therefore appeared 1 GHZ CPU, even dual-core and four-core. From these equipments, we can already see complete graphical user interface. Good MMI (Man Machine Interface) is a very important part in mobile-phone software system, because it can be used friendly^[2]. At the same time, the mobile phone cameras also developed from the original single photographic function to the present take video function. Some high-level mobile phone cameras can even equal the digital camera, and also can do web camera. Mobile phone slowly changed people's lives and close to consumer electronic products. Gradually, a lot of nouns applied on digital camera appeared on mobile phone, such as the sensitive element, automatic focus, optical zoom, shading and so on. After taking pictures by mobile phone, there will be more humanized application operation on UI design, such as sending by E-mail attachment, happy net; Sina micro-blog, Renren net, etc. It shows that mobile phone camera is no longer a "concept", but the real function design for consumers to use. Many mobile phone design company threw into more thinking in camera hardware selection, bottom configuration, upper UI design^[1]. Focusing on powerful function, mobile phone manufacturers are also gradually begin to pay close attention to some customers' requirements, improvement of technical parameters, and the effect of mobile phone camera imaging become the important index of measuring a smart phone. At this time, there emerges a group of mobiles with their selling points is photographic function. Of course, in order to pursue high performance index blindly, some manufacturers also cheat: use the software method to interpolate camera imaging. For example: interpolate 5 million camera to 8 million pixels in the software algorithm, which is high-level mobile phone. After taking pictures, customers can get 8 million

pixels pictures, but the effect is much poorer than the real hardware 8 million pixels mobiles.

Based on the gradually improved user experience requirement, we have to value the objective performance index of smart phone camera. After we complain the mobile phone is not good, we need to know that which performance index of the camera is not good^[5]. At present, the camera's performance evaluation mainly has two aspects: 1, objective evaluation 2, subjective evaluation. This paper analyzes the two aspects of the evaluation method and comprehensive evaluation, and suggestions are also included.

II.OBJECTIVE EVALUATION METHOD AND INDEX

A.Resolution

Resolution react the lens' reappearance ability of object point. Each lens has its resolution limitation, such as an optical resolution for 5 million pixels lens, if put a 10 million pixels CMOS sensor in its imaging circles, it is great waste of the CMOS sensor. Therefore, the camera resolution capacity needs test clearly.

When test, fix chart card (ISO 12233) vertically on the wall. Light illumination is 600 lux or so, which can guarantee the whole chart surface brightness value of ISO12233 is less than 20%. Mobile phones and related parameter on take pictures is set to automatic mode (such as automatic exposure, automatic white balance, etc.), the resolution is set to maximum. Move the mobile phone to make sure the optical axis of camera is vertical to ISO12233 Chart, and make 4:3 area of ISO12233 Chart is exactly within mobile phone preview picture, as shown in Figure 1 red line box:

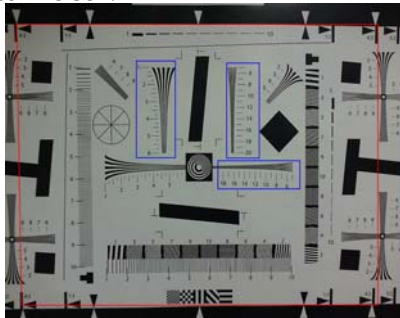


Fig. 1

Fix phone with a tripod, take pictures aiming at the red box area. Import the photos into computer, analysis blue line area image in Fig.1. Read from low frequency wedge line to high frequency line, when the line number changes (5->4, 9->8), the scale value n in the image is the visual resolution, the unit is 100 LW/PH. Adjust the position of mobile phone, make its pictures area can include chart surrounding wedge line. Use the same methods to read surrounding visual resolution value. Generally speaking, for 5M camera, the center area reaches 1200 can be qualified, and achieves 1400 can be excellent. Surrounding area reaches 1000 can be qualified, and achieves 1300 can be outstanding.

According to lots of data description, the resolution test can also measure by Imatest software on MTF (Modulation Transfer Function) index. This index can be optimized by interpolation arithmetic. That is in mobile phone internal DSP chip, enlarge the image with the most near method interpolation and linear interpolation method when needed, increase the pixel and the photos can satisfy the test requirements, such as MTF index. But in this way, the picture can't be the same with the real imaging picture and its resolution is also not as well as the real ones. This faking method can be detected through resolution methods.

B.Luminance uniformity

Luminance uniformity means the brightness ratio of four corners to center, and it is used to describe photos evenness (especially white screen), so it is often called: Shading.

Adjust the light box to D65 light and make sure there is no other interference in the uniform light source place. Fix terminals and all parameters are automatic mode. The distance between camera and test chart is about 2cm~5cm which make preview interface is uniform light surface. Pay attention that, the white test chart cannot use A4 printing paper, because the A4 may add fluorescent powder lead to white deviation. Import the pictures into the computer and use Imatest to calculate brightness average IA、IB、IC、ID、IE of four corners and center A、B、C、D、E region 40 * 40 pixels sampling frame in Figure2. The average brightness ratio of four corners and center is the brightness uniformity, which is calculated as follows^[3]:

$$K_i = I_i / I_E \quad (i = A、B、C、D)$$

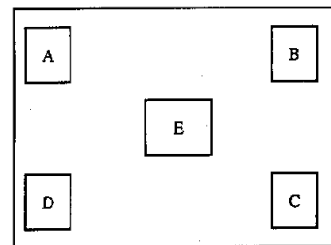


Fig. 2

After using Imatest to process the photos, the output result is shown in Figure 3. For the camera over 1.3M, we need to focus on the data in Figure3 in the red box and if the data is greater than 85%, we can think the index can meet the requirement.

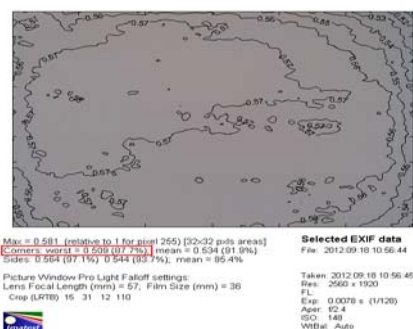


Fig. 3

C. Color checker

Color checker means the object color through the lens compared to the original color, which is the color of the reproduction capacity. This index is often confused with color saturation by people. Generally speaking, the color saturation means, through the lens, the color bright degree of object. When color saturation is 110%~120%, the picture is suitable for the human eyes, and does not make human eyes visual fatigue. The color saturation of Iphone is about 120%, so the photos look more bright and colored and loved by lots of users. While the color judgment is also related with user's subjective feeling, therefore, only 100% reproduce the original object color can meet users' basic requirements.

Adjust light box to D65 light and all parameters are automatic mode. Put GretagMacbeth ColorChecker 24 color charter in the center of light box and move mobile phone position to make sure that whole chart is in 70% of mobile phone preview. Choose 1# to 18# area of ColorChecker 24-color charter as the study object. Figure 4 is a terminal color check test results, square is the ideal value and round is the actual test result. The value in first red box is the result of color saturation, and generally at about 110%~120%, this index can be treated as reference. In the second red box, ΔC is the average of color deviation. It is perfect if ΔC less than 8 and meet the basic requirement if ΔC less than 12. ΔE is the root mean square value of color deviation. It is perfect if ΔE less than 10 and meet the basic requirement if ΔE less than 12. According to this result, we can know each color reproduction capacity of the terminal^[4].

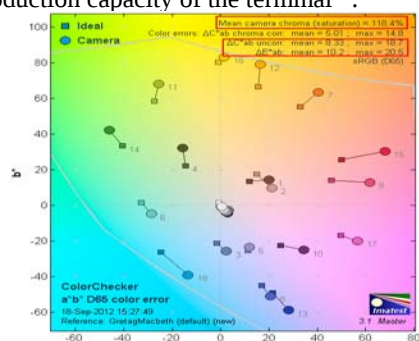


Fig.4

III.SUBJECTIVE EVALUATION METHOD

Whether the camera performance can meet the users' requirement after objective test? There are many factors influence the camera performance, so the comprehensive evaluation process is more complicated. It is found that, the mobile phone camera that can pass the objective performance standards does not can fully meet the requirements of the customers. Generally speaking, after the objective index test, we need to do subjective evaluation in actual scene, and then we can judge whether the camera performance can meet our requirement.

Subjective evaluation method mainly can be divided into indoor imaging, outdoor imaging and night scene. Indoor imaging can choose persons, portrait, different color items in office and other natural goals. We need to focus on color and detail reproduction effect. Attention should be paid to take photos in different light, such as strong, weak light and so on. Outdoor scene should include front lighting and backlighting scene. We can choose the blue sky, plants, flowers and plants, building, grass, garage and the roadside scenery. In outdoor scene, all the attention matters is the same with in indoor imaging shooting.

IV.CONCLUSION

The evaluation of a camera requires a combination of objective and subjective evaluation results. If an objective index is good but subjective situation is not acceptable, we need to analyze reasons from subjective and objective two aspects respectively. Objectively, make ensure all the test conditions are consistent, test in standard light box environment, different ambient light color temperature accurately. Test results should be analyzed by Imatest, nor other non-standard analysis software. In subjective aspect, evaluate photos both on the mobile phone screen and computer screen. On the computer, use professional display color monitor and PC color management software to calibrate the computer color, while sometimes mobile phone screen will be affected by the LCD color, thus make a wrong judgment to the pictures. So if we encounter this kind of situation, generally we can follow the computer effect. Subjective evaluation of camera needs based on objective evaluation; check all the default scene effect after objective evaluation. There is a suggestion that establish a camera performance evaluation system, full marks is 100. The subjective scores and objective scores is 50 points respectively. In objective aspect, evaluate different index score respectively and subjectively evaluate different scene score results. The sum score of the two aspects can reflect this type of camera performance.

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