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# Double is everything

smartphone dual camera is taking the  
world by storm



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Before iPhone launches 7 Plus in 2016, fans were excited about its new dual camera, most people know dual camera is going to be better, but they might not know what's exactly good about it. So what does dual camera do? Why is it better than single camera? The first is to add clarity of the image with the help of monochrome feature and the second is for zooming purpose. One camera is used to take the pictures and the other one is to capture the depth of field. For example, human eyes are a typical binocular system, you can do a small experiment: close one eye, then the left and right hand with a pen, try to make the tip of the pen touch, can you do it? if you look at the same object with both eyes, you can clearly feel the difference, the difference is that we form the basis for 3D vision, with the differences in left and right eye image, cooperate with the matching ability, you can determine the basic object distance from yourself, in the experiment you only opened one eye, although can clearly see the pens on your hand, the brain can not draw depth information, so you can accurately distinguish "UDLR" positioning, but nothing

about "front and behind" positioning. And the creation of dual cameras, could also change this deficiency.

From iPhone 7 Plus generation, it beaten the older generations, which iPhone 6 camera sensor is 1/3-inch, with an equivalent focal length of  $4.15 \times 7.21 = 29.92$  mm, meaning under the same effective pixel, it will create more noise. iPhone 7 Plus mostly used RGB+Mono and Wide+Tele, the left lens is wide-angle 28 mm focal lens, the right lens offers a telephoto lens, equivalent to a 56 mm lens, but on iPhone, main camera aperture is  $f/1.8$ , vice camera aperture is  $f/2.8$ . The pixels themselves also, grew from 1.22 microns (micrometers) across to 1.4 microns — which should help with image quality across the board. But there's an interesting, subtler development that has continually but quietly changed ever since its introduction: the "focus pixels." That's Apple's brand name for phase detection autofocus (PDAF) points, The basic idea is that you mask off half a sub-pixel every once in a while (which I guess makes it a sub-sub-pixel), and by observing how light enters these half-covered detectors you



can tell whether something is in focus or not..

One year later, iPhone 8 Plus launched with better Portrait Mode function than the previous generations, it added new portrait lighting mode, and can take Portrait photos with a layered sense of depth of field. It worked out how the facial features in front of the camera would be affected by the light by computing and artificial learning, use the data to create different light effects. Compare to the iPhone 8, iPhone X and XR has not changed much, but it improved aperture, the vice camera aperture changed to f/2.2, meaning that even in the low light environment, light can be brought in faster.

After talking about such a great functions of dual camera, you might think that will you no longer have to tote around your Canon or Nikon to a photoshoot? Well, it really depends on what you need, the fact is no matter how greater will be the iPhone camera, it will not be able to replace DSLR. So there must be a difference between professional and non-professional. But if you love taking photos about your daily lifestyle, iPhone dual camera is more than enough, while the mobile phone also has the advantages of its convenience. So people willing to buy iPhone with new models every year no matter what the cost.



iPhone 6, single camera



iPhone X, dual camera

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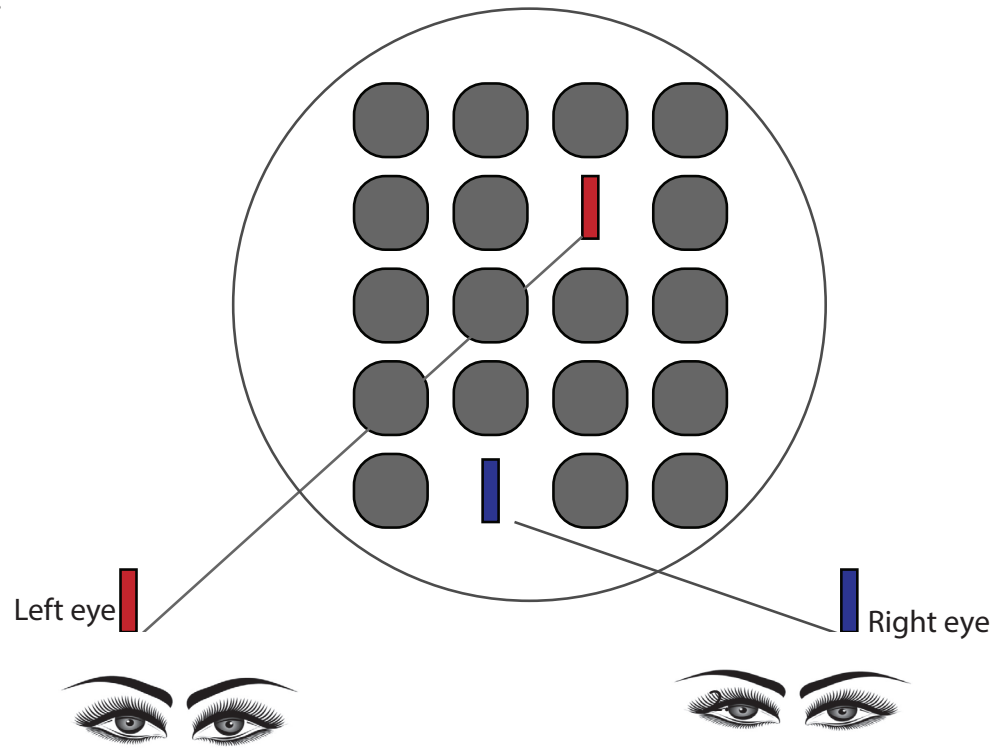
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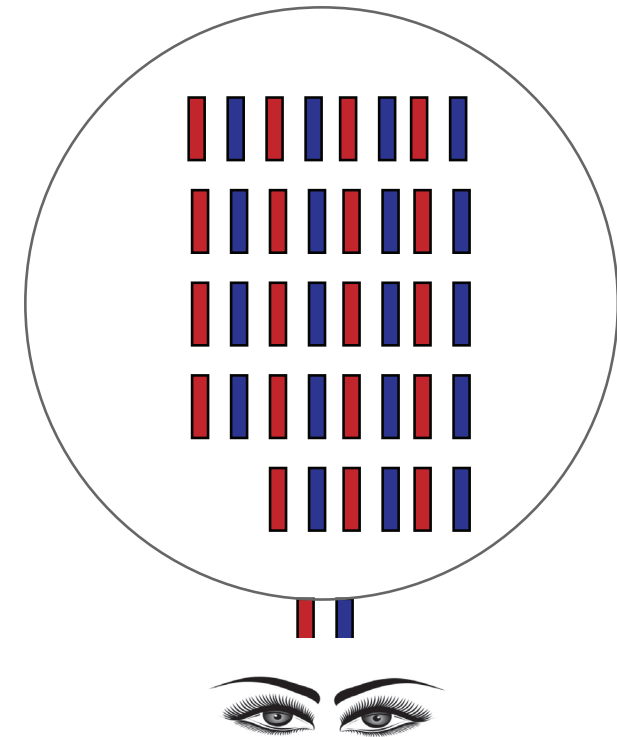
# Principles of Phase Detection Autofocus

1.



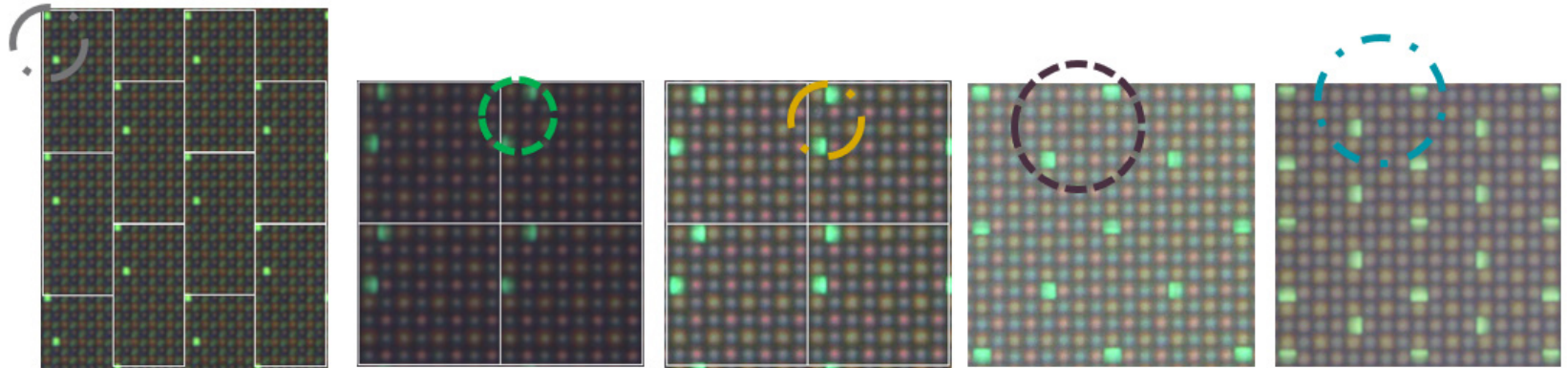
Limited pixel for phase detection  
requires more time to get focusing

2.



Every single pixel enables **precise and fast focusing** like human eyes  
**Larger pixel** collect more light

color filter ->



iPhone 6 Plus

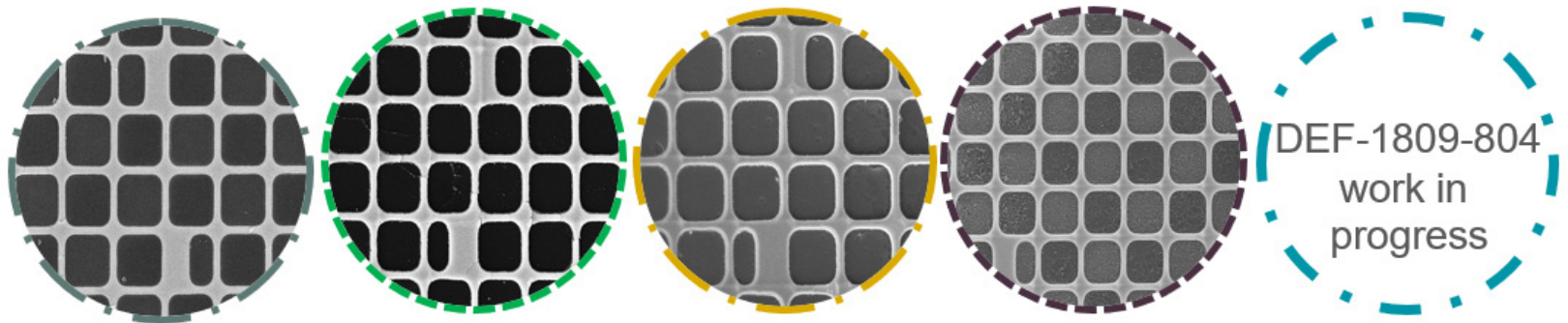
iPhone 6s Plus

iPhone 7 Plus  
wide-angle

iPhone 8 Plus  
wide-angle

iPhone Xs Max  
wide-angle

grid ->



iPhone 6

iPhone 6s

iPhone 7

iPhone 8

iPhone Xs

2014

2015

2016

2017

2018

DEF-1809-804  
work in  
progress



## iPhone X Photography

