Why is the camera sensor size on a smartphone more important than the number of 'dots'?

High resolution is not an important factor in deciding image quality.

In just the past few years, the camera on smartphones has been greatly improved in quality. This is also one of the factors that smartphone manufacturers pay special attention to, especially on high-end smartphones priced at tens of millions of dong.

At the present time, the competition for camera quality on smartphones has opened a race for the number of megapixels, also known as the "dots". Most smartphones now have 48MP, 64MMP, or even 108MP high-resolution cameras on the Galaxy S20 Ultra. However, while the "dot" race may be a popular trend that every manufacturer is involved in, but above all, sensor size is an important factor that affects quality. image, rather than the number of pixels on a sensor.

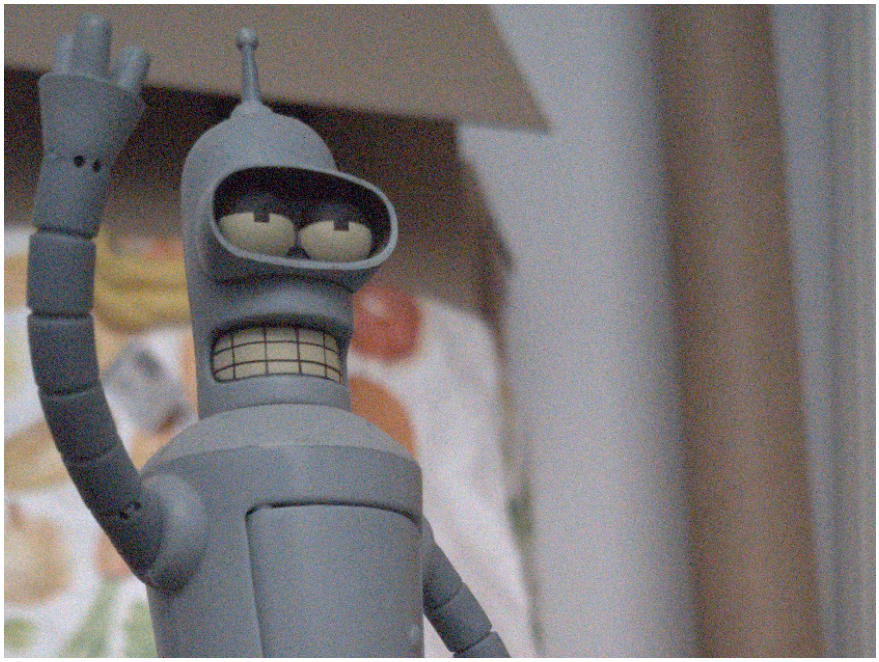
Camera 108MP on Galaxy S20 Ultra

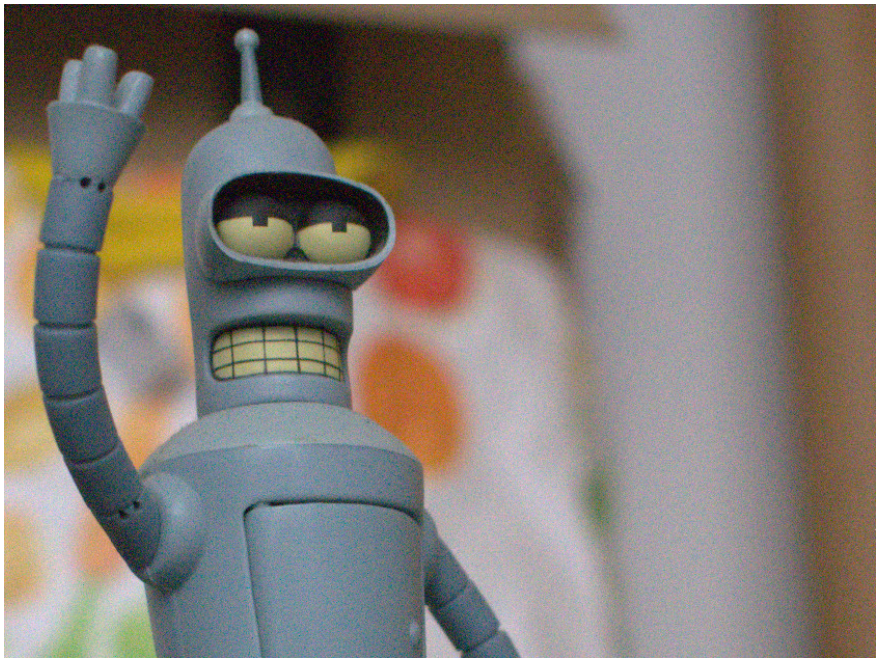
Huawei was one of the first manufacturers to do this when equipping its product, the Huawei P40 a sensor larger than its competitors in the market. Both Samsung and Sony also emphasize on the sensor size on their flagship when introduced to the user. But why and why is sensor size an important determinant of image quality?

To understand why, we need to understand what is the cradle of photography. That is the light. And the image quality depends very much on the light that a sensor receives. Therefore, with a larger size, the larger sensor will also receive more light. The more light, of course, the picture will look better, at least in theory.

Larger sensor: Better light capture, larger dynamic range and clearer images

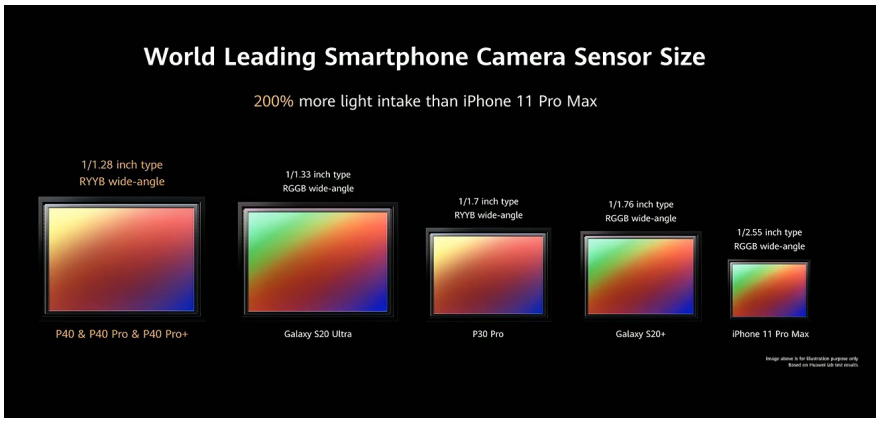
Basically, the size of the sensor determines how much light is needed to create an image. While image resolution plays an important role in reproducing details of image bwsfc, the amount of light the sensor receives will determine other factors such as brightness balance, dynamic range. (Dynamic Range) and sharpness of the image. This is also part of the reason why the 16MP, 20MP or 24MP resolution of DSLR or Mirrorless camera devices can produce much better images than the 108MP camera of a smartphone.





RAW photos were taken from Pixel 4 and Nikon D3300 DSLRs with the same shutter speed of 1 / 20s and ISO 800

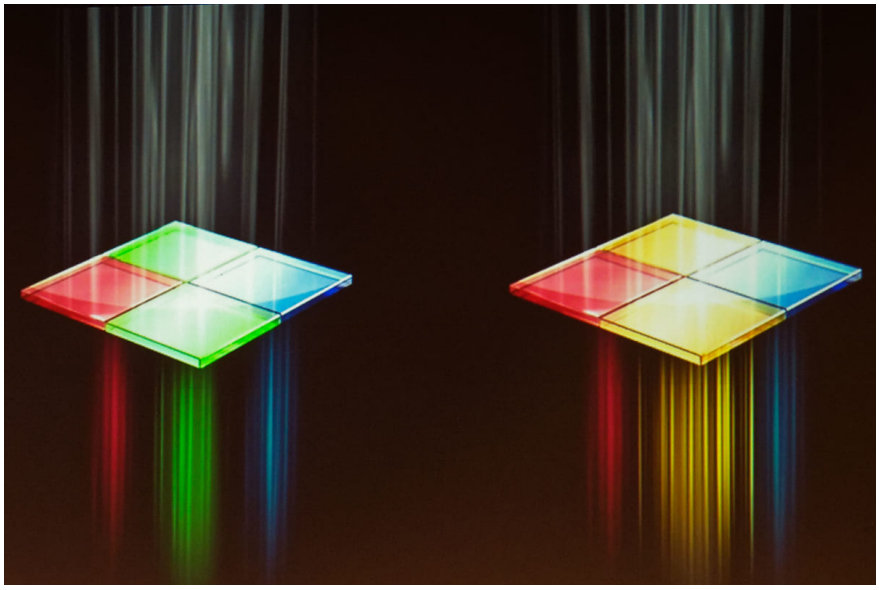
Most smartphones today have a sensor size of about 1 / 2.55 inches, which is about 1cm diagonal. Although some new smartphones have larger sensors, about 1 / 1.7 inches or larger, this number is still nothing compared to the sensors of a DSLR camera, usually larger than 1 inch, which is about 4 to 5 times more than the "tiny" sensor on a smartphone, although manufacturers are still trying to close this gap by increasing the size of the camera sensor on smartphones. Typically, Huawei with the P40 / P40 Pro and P40 Pro + with sensor sizes up to 1 / 1.28 inches, the largest on the smartphone market today.



The camera sensor on Huawei P40 is the largest in the smartphone world today

With the same parameters of shutter speed, aperture and ISO, this larger sensor will capture more light. While we can change factors like shutter speed to capture the same amount of light, this also results in a blurry and blurred image due to the longest exposure time, is when photographing moving objects. The same thing happens when we open the aperture of the lens to capture more light, the image will have a lot of aberrations, and the depth of field will be reduced making objects more likely to be out of focus. Of course, increasing the ISO is even worse when the image will have a much reduced quality due to noise.

Photosensitivity points, also known as photosites, convert light into electronic signals, arranged according to the layout of the sensor, but usually one photoite per pixel. The more light that these points capture, the better the dynamic range of the image (the distance between light and dark areas).



Normal RGGB sensor and RYYB sensor on Huawei P40

The size of the photosite points also depends on the image resolution as well as the sensor size. With the sensor size constant, but the number of pixels is more, then the photosite will be forced to shrink to be able to "fit" enough number of large pixels.

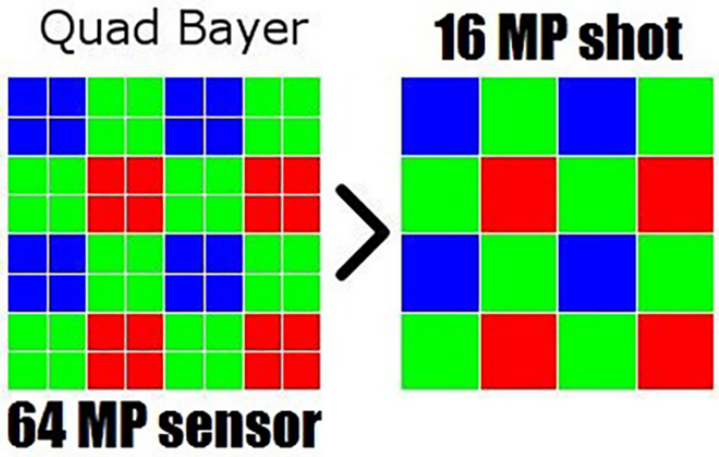
This is especially important because once the photosite is shrunk, the distance between them will decrease accordingly, so that the amount of light of a captured photosite can leak to the next photosite. This is the cause of sensor noise and can often be seen with photos taken in low light or blue skies. Smaller sensors and smaller photosites increase noise and reduce the dynamic range of the image.

Sensor noise phenomenon

Why is sensor size so important?

Now the sensor on smartphones has reached an extremely high resolution (more than 100MP), which can capture extremely detailed images in extremely bright environments. So keeping the pixel size to the right size to optimize the potential of high resolution 48, 64 or 108MP is a necessity. And sensor size is the answer to this problem.

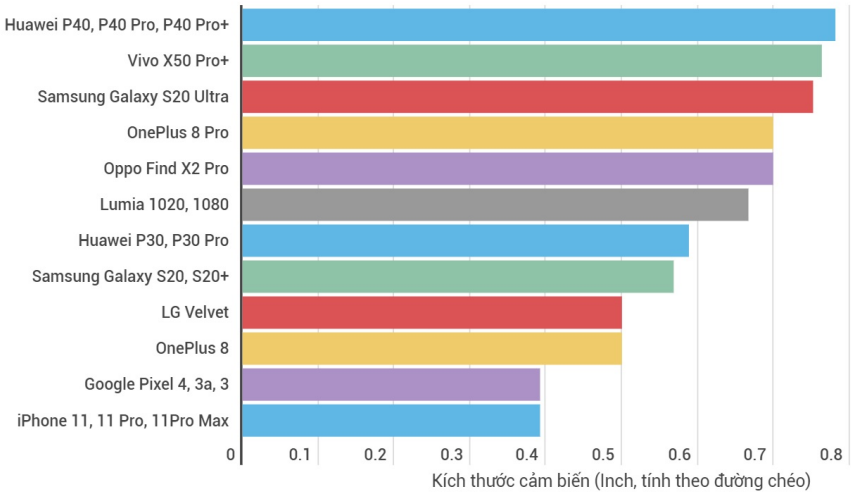
One of the new trends in high-resolution smartphones today is pixel-binning technology, which allows the camera's camera to combine 4 or 9 pixels together to produce images. The best quality, the least noise even in low light conditions.



Pixel-binning technology allows the smartphone camera to combine 4 or 9 pixels into 1 pixel

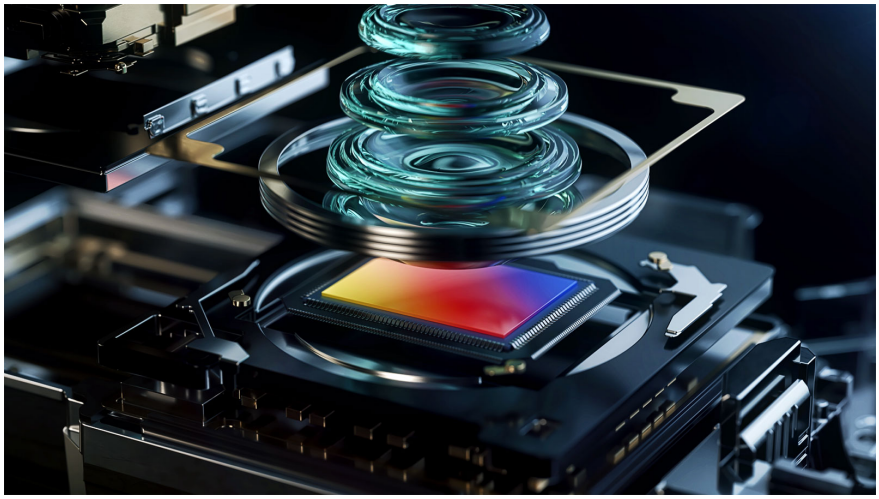
The larger sensor is also one of the factors that makes photos look better with a more naturally deleted background (bokeh effect), which allows the subject to become separate from the background. This is an ability that only DSLR camera devices can do, and thanks to the large sensor size, smartphones can close this gap.

To compare and have a better view, here is a comparison of sensor sizes on popular smartphone models today.



The large sensor is a prerequisite for improving low-light capabilities on smartphones

It will not be until 2020 for users to experience smartphones with a camera sensor size larger than 1 / 1.5 inch, this is the size that appeared on the Nokia Lumia 1020 in 2013, one of historic monuments on mobile photography. The large sensor is not a new idea, but because it does not bring a marketing effect large enough to attract users like the number of "dots", new manufacturers do not attach importance to improvement. However, until the race for resolution becomes saturated, we will probably see more significant upgrades in sensor size, and manufacturers will be ready for that. .



Of course, we also need to note that in the top rankings, the Pixel 4 and iPhone 11 Pro Max are at the bottom of the table, but still rated as 2 of the best and best smartphone photography today. . Obviously, sensor size is only an important factor when it comes to hardware, software elements and image processing algorithms will also continue to be a decisive factor in photographic quality.

Understanding the hardware limitations of a smartphone is also the premise for computational photography to flourish. Computer photography uses software and algorithms as well as leverages the power of artificial intelligence to process the original image taken by a smartphone. In the near future, besides sensor size, the race for computer photography will also be a new trend on smartphones to help users produce beautiful pictures no different from specialized cameras.

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