Pixometry

Image Resolution and Size

A Clear and Practical Guide

1. Introduction

Image resolution is a term you see everywhere in photography, printing, design, and digital media — yet it is often misunderstood. People talk about *pixels*, *DPI*, and *inches*, but many don't know how these relate. This guide explains what image resolution *really* means, how the different measures relate to each other, and how to use them correctly when working with images for screen or print.

By the end, you'll understand:

- what resolution really is,
- why DPI matters in some contexts but not others,
- and how to calculate image sizes and quality for different outputs.

No unnecessary jargon — just practical insight.

2. Three Ways to Describe Resolution

When we talk about *image resolution*, we are really describing the same information in **three different but related ways**:

1. **Number of pixels** (pixels = picture elements)

   – The total count of individual picture elements that make up an image.

2. **DPI (dots per inch)**

   – The number of pixels (or dots) placed per inch when an image is displayed or printed.

3. **Physical size in inches**

   – How large the image will appear in the real world (we'll focus on inches in this article, though metric units work the same way).

These three measures are linked: if you know **any two**, you can calculate the third. Later in this article we'll walk through examples that show exactly how to do that.

3. Camera Resolution

A digital image is made up of tiny picture elements called **pixels**. Inside a camera, a lens focuses the actual scene onto an image sensor. This sensor contains millions of light-sensitive elements, each capturing a small part of the scene. The camera then translates that information into pixels — a process that converts light into a digital representation of the scene.

The more pixels a camera's sensor has, the more detail it can record from the original scene. In this sense, **resolution refers directly to the number of pixels**: more pixels generally mean more detail and higher resolution.

But what about DPI — isn't that what resolution means? Let's look more closely.

Why Camera Resolution Is Not Described in DPI

Camera resolution is expressed in terms of the number of pixels on the sensor — not in DPI. This is fundamentally different from how scanners and printers are typically described.

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PENTAX

Pentax K-3 Mark III Digital SLR in Silver with Pentax HD 20-40mm F2.8-4 ED DC WR Lens in Silver

› 25.73 megapixel BSI sensor
› Bright TTL prism finder with 100% field of view
› Pixel Shift function for higher image quality
› Body-integrated SR II system
› SAFOX 13 autofocus system with 101 sensors

(1 megapixel is 1 million pixels)

Scanner Resolution

Like a camera, a scanner translates an image into pixels using a sensor with light-sensitive elements. The key difference is that the physical size of the original is known. For example, scanning a letter-sized sheet (8.5 × 11 inches) at 300 DPI produces:

```
None
(8.5 × 300) × (11 × 300) = 2550 × 3300 pixels ≈ 8.4 million pixels
(or 8.4 megapixel)
```

Because the size of the original is known, the scanner's resolution can meaningfully be expressed in DPI.

Printer Resolution

A printer works in reverse: it takes digital pixel information and places dots on a physical medium. Since the output size is known, DPI is a useful way to describe how densely the printer places dots.

Why DPI Doesn't Make Sense for Camera Capture

A camera can take pictures of scenes that vary without limit in physical size. You might photograph a small flower up close with a macro lens or capture a vast landscape from a mountain top with a wide-angle lens. Both shots will result in the same number of pixels, but the physical size of the scene is very different. Because the actual *size of the original scene* is not defined when the image is captured, expressing camera resolution in DPI does not make sense.

In Summary

- **Camera resolution** describes how many pixels the sensor captures — that is the true measure of the detail in a digital photo.
- **DPI** is meaningful only when the image is tied to a specific physical size — as in scanning or printing.
- A camera does not record physical scene size, so DPI is irrelevant at the moment of capture.

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4. The Image File

Let's examine what is actually contained in an image file, using a JPEG as an example.

If you want to know the *true resolution* of an image file, the first thing you should look at is the **number of pixels** — that is the real measure of image detail. The DPI value stored inside a JPEG tells you *nothing about the actual resolution* of the image data itself. Here's why.

A JPEG file is composed of two parts:

1. **Pixel data** — the actual image information (the color values for each pixel), and
2. **Metadata** — information about the file, such as camera settings, color profile, and DPI.

The DPI value stored in the metadata is not part of the image content; it is simply an **output intent**. It tells software how the creator *intended* the image to be displayed or printed, but it does not affect the number of pixels or the detail in the image.

⁂ **Important point:** You can change the DPI value without changing the image itself.

For example, if you open a JPEG in Photoshop and edit the DPI from 300 to 72 — *without resampling* — you have not added or removed any pixels. The image data remains exactly the same. You have only changed a metadata tag that tells some programs how large the image *should* be interpreted when printed or displayed.

In Photoshop, this is done by making sure the **"Resample"** option is *unchecked*. That way, changing the DPI only updates the metadata — it does **not** change the pixel dimensions or image detail.

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5. DPI (Dots Per Inch)

We've already seen that DPI does not describe the *intrinsic* resolution of an image — that is always determined by the number of pixels. So when does DPI *matter*? The answer is: **as soon as you output the image**, whether to a screen or to print.

DPI for Screen vs Print

Different output contexts use different DPI values:

- **Digital display (screen/web)** — often around **96 DPI**
- **High-quality print** — commonly **300 DPI**

To know how many pixels you need for a specific output size, you can use the simple formula:

```
None
Required pixels = output size (in inches) × DPI
```

Let's say you want your image to be **5 inches wide** (and since it's square, also 5 inches tall):

Print at 300 DPI

```
None
5 inches × 300 DPI = 1500 pixels
```

So a **1500 × 1500 pixel** image (≈ 2.25 million pixels, or ~2.2 megapixels) contains enough information to print a 5 × 5 inch image at 300 DPI with good quality.

Display at 96 DPI

```
None
5 inches × 96 DPI = 480 pixels
```

On a screen at 96 DPI, a **480 × 480 pixel** image (≈ 230,400 pixels, or ~0.2 megapixels) is sufficient to fill the same 5 × 5 inch area.

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What DPI Actually Means in Practice

As we discussed earlier, the DPI value inside an image file is just metadata — it does *not* change the actual pixel data. However, software uses that DPI value to calculate physical size:

- Applications such as Photoshop look at the pixel dimensions and the stored DPI value to compute and display the physical size in inches.
- If you change the DPI without resampling, the pixel count stays the same and only the *interpretation* of the size changes.

In Photoshop, as long as **“Resample” is unchecked**, altering the DPI simply updates that output intent — no pixels are added or removed. If you *do* check “Resample”, Photoshop assumes you want to *keep the physical size the same* and will add or remove pixels accordingly to match the new DPI.

Effective Resolution in Layout Software

In layout applications like Adobe InDesign, there is another useful concept called **effective resolution**. When you place an image into a layout:

1. InDesign takes the image’s pixel dimensions.
2. It takes the size you *place* it at (in inches).
3. It calculates the DPI that results from those two factors.

For example:

- You have a **3000 × 3000 pixel** image (≈ 9 megapixels).
- You place it into a 5 × 5 inch frame in your layout.

Then:

```
None
3000 pixels ÷ 5 inches = 600 DPI (effective resolution)
```

This means the image, as placed, has **600 DPI of detail**. If your print target is 300 DPI, this image has more than enough resolution and will render sharply.

If the **effective resolution is less than your print requirement** (for example < 300 DPI for high-quality print), you may need a higher-resolution source image — or, if appropriate for the project, use an AI-based upscaling tool to increase detail.

Summary of Key Points in This Section

- DPI becomes relevant only at *output* (screen or print).
- You can calculate required pixels by multiplying intended size by targeted DPI.
- The DPI value in the file is metadata — it does not change image data.
- Photoshop and other tools use DPI to calculate output dimensions
- Effective resolution is a practical measure used in page layout based on placed size and pixel count.

Conclusion

Understanding image resolution doesn't have to be complicated. At its core, resolution is about the amount of image information and how that information is interpreted for a specific output. DPI is meaningful when you map pixels to a physical size, such as on screen or in print.

By focusing on pixels as the true measure of detail and using simple calculations to determine how many pixels you need for your intended output, you can make confident and informed decisions in any workflow — from photography and design to web and print.

With this foundation, you can assess image quality accurately and choose the right resolution for every purpose.