

A Brief History of Images on the Web

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Abstract

This article explores the history of images on the Web, starting with a definition of 'image' and an overview of human-created images, from Stone Age paintings to portraits. It then presents essential milestones in developing digital images, such as the first digitized photograph, the evolution of digital cameras, image editor software, and image file formats. Finally, it explores the history of images on the Web, recounting the story of the first photograph on the network and the technological advancements leading up to the present day, including social media platforms for photo sharing and the emergence of AI-generated imagery. The article concludes with a brief discussion on the future of images on the Web.

CCS Concepts

- Social and professional topics → History of computing; • Information systems → World Wide Web.

Keywords

World Wide Web, History, HTML, Images, Web Development

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1 The human being and images

For this paper, we are considering the definition "An image is a visual representation" [52]. This simple and flexible definition allows us to consider images presented in diverse forms, from stone paintings to digital art on smartphones. It also enables us to include photographs as images, as they are generated through the exposure to light of light-sensitive materials by humans who wish to represent fragments of reality [50].

With this definition in mind, we can explore the key milestones in human history regarding the production of images. One of the earliest known human-created images is a painting found on a stone, dating back more than 73,000 years. This is a record from the Stone Age, consisting of several lines made with red pigment on a rock discovered in a cave in South Africa in 2011 [38].

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Over time, artists began to create portraits, capturing the likenesses of individuals. Long before the Renaissance painters, many people had been portrayed in paintings. Paintings of portraits associated with mummified bodies were found in Egypt, dating back to the first and second centuries BC. [9, 44]. Research suggests that the first self-portrait was painted in 1433 in the Netherlands [33].

The earliest known photograph (1822) was lost with no copies. The oldest available photo, taken in 1826, shows house roofs [40]. Early photos were black and white or later colorized. The first true color photo, using Maxwell's three-color method, was taken in 1861.

This article covers the history of Web images, so a brief look at computational history is needed. The first programmable computer, ENIAC (1945) [54], lacked image display capability. The first graphical interface computer, Xerox PARC's Alto, was introduced in 1973 [37].

From this foundational information, we can now proceed to explore the topic of digital images, which precede their use on the Web.

2 The digital image before the web

Even before the invention of graphical interfaces in computers, the first digital image had already been displayed on a computational device in 1957 when Russell Kirsch and his colleagues created a scanner that enabled the digitization of an image. Kirsch used a photograph of his three-month-old son for the test. This monochrome image, 176 pixels large on one side, became immortalized as the first digital image [35].

In 1975, Kodak launched the first digital camera, which recorded images on cassette tapes [42]. This initial model was purely experimental but could take pictures. The first color digital photograph was taken in 1972 by Michael Francis Tompsett, utilizing CCD sensor technology, and depicted his wife, Margaret Tompsett [18].

The evolution of digital imagery was not limited to cameras; computers also underwent a technological revolution. They transitioned from large, room-filling machines to personal computers available in homes in the early 1970s [51].

In the 1980s, graphical interfaces gained color, and digital image formats emerged [51]. Microsoft introduced BMP [43], but its lack of compression led to large files. JPEG, developed in 1992 [27], improved compression based on earlier techniques from 1972 [29]. GIF, introduced in 1987, became key for web images, supporting animation, transparency, and compression. In 1987 Stephen Wilhite created the first GIF, an image of an airplane with moving clouds [3].

This technological evolution set the stage for a new transformative technology that would forever change how we interact with visual content: the World Wide Web, introduced in 1989 [10].

3 Images on the Web

When the Web first emerged, it was just text with hyperlinks. It took a few years for images to be introduced into the markup language. The credit for the first photo published on the Web goes to the image of the *Les Horribles Cernettes*, which, according to some sources, in 1992, Tim Berners-Lee had asked Silvano de Gennaro for an image to publish in his experiments on the Web, and the one that was given would have been the cover of the band's CD with the four members [48].

This story is questioned by researchers and by Silvano himself, who confirms that the story of the first photo is a myth. According to him, the cover of the CD is not the first photo on the Web, but the one that opened the Web to the world [23]. The band members also published on their website that this is the first photo of a band on the Web [11].

3.1 Markup for images

Regardless of which image was the first one published on the Web, the `IMG` element was added to the HTML documentation. Marc Andreessen began discussing it in an email list in February 1993 as a new element for the markup language [2]. The addition of the tag was not accepted by the entire group. Some members argued that introducing a tag for images could pave the way for the creation of other tags, such as those for audio. Considering the internet speed at the beginning of the '90s, this was an important issue. Tim Berners-Lee was also hesitant, suggesting the use of an anchor element to display inline images [31]. Despite some resistance, in June of the same year, a draft of HTML 1 was published, which included the `IMG` element [6].

Essential attributes for images were already present in this version, such as `SRC`, which defines the URL of the embedded image; `ALIGN`, for vertical alignment; and `ALT`, for adding alternative text for text-only browsers. The `ALT` attribute has a vital role in digital accessibility, allowing assistive technologies to access content in text [21]. In the HTML 2 document, the `image` element introduced the `ISMAP` attribute, indicating an image map. At the same time, form submission buttons (`INPUT`) gained the possibility of having an image resource to display using the `type=image` attribute [46].

The use of the `ALT` attribute was initially confusing, and it should not be displayed when the image is loaded. However, due to a bug in Internet Explorer in the 1990s, `ALT` was widely used as a tooltip when the user hovered over the image (similar to the `title` attribute behavior) [36, 45].

Using text alternatives for images is so important that the WCAG document defines several ways to make images accessible, from adding alternative text (using the `alt` or `aria-label` attribute) to techniques for detailed descriptions [20].

The early web browsers did not display images. The WorldWideWeb browser developed by Tim Berners-Lee only displayed text. The Mosaic browser, released in 1993, was the first to display images [34]. This was the beginning of a new phase of the Web, going beyond just text. The first web banner advertisement was published on October 27, 1994, on the hotwired.com website. It was a rectangular image format with an advertisement for AT&T [32].

In HTML 3.2, a document released in 1997, new attributes for adjusting the image were added, such as `height`, `width`, `border`, `hspace`,

`vspace`, and `usemap` [39]. From this version onward, adding a background image to an HTML container element became possible using the `background` attribute. HTML 4, published in 1999, incorporated the `longdesc` and `name` attributes into the `IMG` element [47].

Images were also incorporated in other specifications. In the first version of the Cascading Style Sheets, level 1 document from 1996, it was already possible to add background images and images in lists [30]. This document is important because it moves customizations from HTML, such as `height`, `width`, `borders`, etc., to the style sheets.

The use of images was prevalent on the Web in the early 2000s (and continued to be favored over the years) [1]. Pages with animated images, logos, and photos began to populate the network. Development was still precarious, and images were necessary for a more elaborate design. During that period, it was quite common to use table elements for positioning images. Software like Adobe Photoshop and ImageReady allowed you to slice images and generate an HTML page with all the images in tables.

3.2 Image formats on the Web

Initially, the web used only bitmap images, which were composed of pixels on the screen. In addition to the GIF and JPG that were already mentioned, the PNG was also a popular bitmap format. It was created in 1995 and published as a W3C recommendation in 1996 [41]. In 2010, Google released the WebP format, allowing lossy and lossless compression, creating images reportedly 25-34% smaller than JPG and PNG images at similar quality levels [19]. Bitmap images can offer good resolution but have resizing limitations.

A solution to the resizing problem is the use of vector images. Since they are composed of points, lines, curves and fills, they can be resized without resolution loss. These images are generated from coordinates and color codes. The vector format is not new. Some documents suggest its use in computer systems in the 1950s and 1960s [53]. The list of vector formats is extensive, including WMF, EPS, PDF, CDR, and AI. The standard developed by the W3C for the Web was SVG, based on the XML format. The first specification of the format was published in 2001 [7].

Incorporating bitmap and vector files in an HTML file was always done the same way, using the `IMG` element through the `SRC` attribute. Only in HTML5 (published as a W3C Recommendation in 2014) the `SVG` element was added to the specification, which allows adding content (such as coordinates, text, and color information) as a container directly in the HTML code, without the need to bring the image from another file [22]. The HTML5 documentation also allows adding a cover image for the `video` element. The `poster` attribute provides the URL of an image file that the user agent can display when no video data is available [49].

3.3 Images over all the Web

After the rise of the Web and content publishing services like blogs, it took some time for image-sharing platforms to emerge. One of the most popular, Fotolog, was launched in 2002 and allowed the publication and sharing of photos and images [17]. Photo storage services like Flickr, launched in 2004, also began to gain traction.

Images were also used to create systems to prevent abuse and improper use of systems. The first CAPTCHA (an acronym for "Completely Automated Public Turing Test to Tell Computers and

"Humans Apart") was created in 2000 for Yahoo and already used the model we are familiar with, with images of distorted characters to prevent access through scripts or automations [25]. The big problem with CAPTCHA is its serious accessibility issues, as it usually does not use alternative text [24].

Although image searching is common on websites today, finding a photo on the Web in the early 2000s was not easy. The user had to navigate through different pages to find a specific image. This was one of the reasons for the creation of Google Image Search in 2001. According to Eric Schmidt, Google's executive at the time, Jennifer Lopez arrived wearing a Versace dress during the 42nd Grammy Awards in Los Angeles in 2000. That drew much attention. After the event, people used Google to search for a photo of the dress but had to navigate through several pages to find it. From there, the idea of incorporating image search into the search engine was born [28].

Social networks were also vectors for the publication and sharing of images. Myspace (2003), Orkut and Facebook (2004), and Twitter (2006), among others, allowed the creation of accounts for publishing content, including images. Being third-party platforms, users could not include alternative text on the images. It took a long time for each social network to allow the insertion of alternative text: Twitter and Facebook only added a feature for adding alternative text in 2016 [15].

We need to mention the use of images for memes on the internet. They are a quick way to convey information in an ironic and fun way. Memes didn't start with the internet. Some linguists claim that humans have used memes to communicate for centuries. Memes are basically editorial cartoons for the Internet age [5]. There is no certainty about the first online meme (probably a version of the dancing baby, spread by email as a video or animated GIF). Using images to share memes has become a creative way to communicate quickly [15].

Photos-sharing became so popular that social networks exclusively for image-sharing began to emerge. Instagram, launched in 2010, allows you to store, view and share content. Unlike Flickr and Fotolog, you need to have an account on the social network to see the photos published on Instagram. It's challenging to map the most shared image on the internet, but the photo of Lionel Messi in the 2022 World Cup final reached over 75 million likes [16].

The Web has significantly influenced the development of AI, particularly in image-generating technologies. ImageNet was one of the main databases that influenced the advancement of image processing algorithm development by collecting the images available on the Web and associating them with semantic concepts. Today, the advancement of AI continues to benefit from the vast amount of content available on the Web, serving as a rich resource for machine learning [12]. It is possible to hypothesize that without the potential of the Web as an image resource, AI would not be at its current stage of development.

The emergence of artificial intelligence tools is also a new chapter in the evolution of images on the Web. Tools that allow the creation of images from a command prompt began to appear in 2014 with the generative adversarial network (GAN) [26]. The most popular tools, such as Midjourney, only emerged in 2022.

Artificial intelligence tools can generate descriptions from images. Facebook has offered this feature on its social network since

2016, and modern tools like ChatGPT have also acquired this capability.

One of the characteristics of digital images is the ability to duplicate or copy them. NFTs (Non-Fungible Tokens) then emerge as a way to create artificial scarcity by allowing each image to have a unique ownership certificate registered on a blockchain. Although copying and pasting the image is still possible, a certificate now indicates who owns the original content. The first NFT image was created in 2014 by the artists Jennifer and Kevin McCoy [13].

As image-capturing technology evolves, features like 360-degree images can be used in scenarios beyond just computer and smartphone screens. Their use in immersive environments, such as virtual reality headsets, is a good example. Although it may seem revolutionary, 360-degree images have already been used on websites through VRML since 1995 [4].

4 The future of images on the Web

The human capacity for creating images has evolved over time and now faces several challenges. The advent of generative AI marks a new chapter in this evolution, resulting in a web increasingly filled with synthetic content. Technologies that generate images from prompts are becoming more popular.

The trend indicates that the Web will evolve into an environment where hybrid realities are created, a space blending natural and synthetic images. One of the challenges we face regarding the future of the Web is identifying the origin of an image so that users can determine whether it is authentic or synthetic. Image manipulation has always existed and had consequences on the Web; however, the novelty will be related to the speed and volume of images created by AI. Artificial intelligence will drive the avalanche of synthetic images on the Web. In this scenario, we must develop and adopt mechanisms to discern the real from the synthetic, understanding the provenance and authenticity of our content.

In this sense, the "Coalition for Content Provenance and Authenticity (C2PA)" was created to "address the prevalence of misleading information online through the development of technical standards for certifying the source and history (or provenance) of media content" [8].

One strategy that C2PA is implementing is using metadata when creating AI content. In this case, it will be possible to identify the origin of the content more easily, but this does not mean that the approach has no limitations. One of the sensitive points is that removing metadata is very simple: a simple screenshot is enough for a new file to be generated without the metadata created by AI.

A more effective technique that is being considered by big tech companies and different research centers is the creation of watermarks in AI-generated content. In this case, removing the information would be very difficult because it would be distributed among the pixels of the image itself [14].

Efforts like the ones above are essential to ensure a more transparent and reliable online experience, where the distinction between real and AI-created content is not just a technical matter but a commitment to information integrity. This is a challenge for the Web of the future.

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