



ORIGINAL RESEARCH PAPER

Computer Science

COMPRESSION STUDY FOR IMAGE OPTIMIZATION TECHNIQUES AVAILABLE FOR JOOMLA-BASED WEBSITES

KEY WORDS: performance, image optimization, website, CMS, joomla, extension.

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ABSTRACT

Nowadays Images represent approximately about half website size, Which effect the performance of website therefore optimization become necessary to avoid increasing image transfer size as well as page load time. Many studies showed that image optimization is lacking on most websites. This study introduced image optimization approaches used with joomla websites. The paper ends up with all optimization approaches reduce total page size and approve overall performance with different level of optimization.

INTRODUCTION

Image Analysis effect the page weight which impact data usage significantly more than half percent of total page weight for desktop or mobile sites represented by images of instance Entertainment websites use large number of images for both mobile and desktop sites, and finance websites as have average image size. In this study compression and optimizations on images has been applied in order to decrease the total overhead while maintaining quality. Our analysis shows that most websites does not apply in image optimization. Image types (GIF,PNG,JPG) act as most used image format each of those format utilize different compression technique in terms of size and quality optimization. We used the OptiPNG image compression technique [1] to convert GIF image to PNG. The analysis an average of 15% file size reduction. Summary Our image overhead analysis showed that image optimization is lacking on most websites. From our average size measurements, we observe that a total of saving of about 263 kilobytes can be realized on desktop sites, and 121 kilobytes for mobile websites. These are significant size reductions that alone can reduce mobile website sizes by an average of 13.1%, and desktop website sizes by an average of 15.1%. The size reduction can be further enhanced if the image quality is appropriately optimized for the target screen quality.

Joomla

Joomla [2]is one of the most sophisticated content management systems available. It's a free open source content publishing system for quickly building highly interactive Multi language Web sites including online communities, media, portals, blogs, and e-commerce applications. Joomla is an open-source content management system that may be used in common , Because it is global, you can modify it to your satisfaction. It is a sensible choice, but Joomla can also be used to blog. by choosing an appropriate template page can be customized. Also joomla have thousands of free template and prepaid professional design templates Using at add-ons the one can extend the functionality His/her website. There are several free extensions available on Joomla, but some require payment. And if user can't find anything suitable, still can always build it from scratch to meet their requirement. Because Joomla is open source, developer can be hired to change the code to suit the needs and enjoy the benefits.

Joomla Characteristics

1. User Administration
2. Template Management

3. Integrated Assistance System
4. System Specifications
5. Web Services
6. Exceptional Extensibility
7. Media Director
8. Banner Administration
9. Management of Contacts
10. Web Link Management
11. Content Administration
12. Newsfeed Maintenance and Syndication

Moreover, Joomla has a great community. The more active users respond queries immediately. In joomla users may ask anything regarding situation and be certain of receiving a prompt response. The community is vibrant and supportive. Joomla also has a strong development team that is always working to improve the platform. Always on the search for problems and give solutions. Incorporate make Joomla more efficient, as well as the new Joomla.org developers' site has a lot of free add-ons, components, modules, and themes. Developers purchase commercial add-ons, modules, components, or templates, or request bespoke Joomla is simple to set up and maintain. Joomla is basic for even a beginner to use. It's straightforward to use, but it contains a wealth of varieties. Joomla can be installed with a single click. It just takes a few minutes to configure. Shopping Carts, Forums, Calendars & Events, Ad serving tools, Search, Google Maps, Business & People, Directories, Classified Ads, Community Portal Tools, Reservations, Automated Backup, Newsletters, Polls Quizzes, Blogs & News, Image Galleries & Portfolio Tools, and Project Management & Groupware seem to be just a few of the extensions available in Joomla.

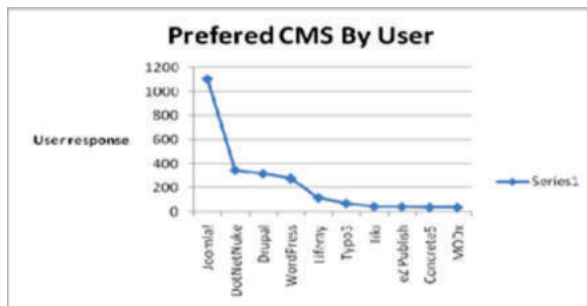


Figure 1: The Statistics Of Preferred CMS By User [1].

Based on statistical study made on sample of 1200 hundred regarding the most preferable CMs for web developers .

Joomla is on the 1st position with more than 1100 response.

Related work

Many studies consider websites characteristics in terms of network level [8],[9] and client level [7]. Previous work concentrate on performance of webpages in latency level than data usage based on download contain page sizes.

Leventic et al [6] introduced Automatic JPG image compression technique which compresses each image iteratively and specifies the highest compression saving the quality of the original image.

Mjelde[10] compared available page load time reduction technique by adapting context.

Huet[11] performed analysis of PNG,JPEG and image compression algorithms such as web P. The result show that web P format was significant to ping format in both compression ratio and time consumption, while the compression ratio and image quality of web P format out performant the JPEG format in lossey compression and the cost of long encoding time.

Pushkear et [12] proposed a website loading speed optimization method with a weighted list of the main criteria for optimizing speed, including criteria related to images. The method was demonstrated on a prototype Joomla-based website, which addressed the formed criteria. For the implementation of efficient im-age compression, several services and programs were considered and evaluated preliminarily, including Cae-sium, RIOT, TinyPNG, Optimizilla, and FileOptimizer, from which the last one was found to be the most efficient, and was therefore used in the process of optimizing the prototype website. With the use of the program, the size of image files has been reduced by 58.55% without significant loss of image quality. Over-all, the authors estimate that the site loading speed improved by 48%. Similar to our study, this study focuses on optimization for CMSs. However, it utilizes external image optimization services and programs and does not make use of the plugin-oriented architecture that could provide automatic optimization. Addition-ally, the study did not only address image optimization, but overall optimization, thus, not providing comprehensive findings regarding web image optimization.

Image Optimization Methods

Number of optimization methods were chosen and used in experiment scenarios . five of them will be known free image optimization extensions from joomla extension directory. The sixth is the default joomla image optimizer.

Image Recycle is a Image and PDF compression extension for Joomla. It can Compress automatically new images & pdf, Run a background optimization of all user images and get notified when it's done , Image automatic resizing , Define an optimization quality images per media type, Optimize png, jpg, gif ,Define compression quality per file type, jpg, png, gif

TinyPNG can made website faster by optimizing user's JPEG, PNG, and WebP images. This plugin automatically optimizes all your images by integrating with the popular image compression services TinyJPG and TinyPNG. It can Automatically optimize new images on upload., Advanced background optimization to speed up user workflow, Optimize individual images already in your media library, Display JPEG images more quickly with progressive JPEG encoding, No file size limits.

compressorio is a Image powerful compression extension for Joomla. It has File type supported to JPEG, PNG , SVG, GIF and WEBP, also Reduce the file size of user images by compressing them without losing any quality, Choosing

between losses and lossless compression, Preserve metadata (Pro) , Fix image orientation (Pro), prefix/suffix to the file name (Pro).

JPEG Optimizer is a free online tool for resizing and compressing your digital photos and images for displaying on the web in forums or blogs, or for sending by email. Completely Free.No software to download.

Optimizilla is the online tool makes use of a smart algorithm that mixes optimization with the appropriate lousy compression type techniques to reduce image size while giving away image quality as less as possible.

Joomla core has supported Several features of image optimization. With joomla image 4.5, the software uncompressed JPEG images. Only the compression factor can be modified; however, only pro- grammatically using a filter hook Large images exceeding 2560 pixels in height or width are scaled down in joomla 3.2. In joomla 3,9, the native HTML loading property was added to enable default lazy loading of images.

Table 1: Comparison Of Image Optimization Approaches (Data Gathered On 13th Of Sep 2021).

	Image Re-cycle	Tiny PNG	Comp ressor .io			joomla imge optimize
				JPEG Optimizer	Optim-izilla	
File size	5.67 MB	17.1 MB	1.11 MB	276 KB	77.8 KB	N/A
image formats	JPEG, PNG, GIF	JPEG, PNC, GIF	JPEG, PNG	JPEG, PNC, GIF	JPEG, PNG	JPEG, PNG

1. Web Performance Metrics

The performance of websites used in the experiment was evaluated from two perspectives: Load time and transfer size. Load time represents the speed at which the end-user browser loads a site. We used the Performance Score, defined by Yellow Lab Tools (Google Developers, 2021b) [4][5], which presents an overall user-perceived performance estimation of a website. It is a weighted average of scores of six performance metrics, each capturing some aspect of website load speed. These metrics are:

- First Contentful Paint (FCP): Time until the first content element is rendered on the page.
- Speed Index (SI): Time required for the content to be displayed visibly on the page.
- Largest Contentful Paint (LCP): Time until the largest content element is rendered on the page.
- Time to Interactive (TTI): Time until the page is fully responsive to interaction.
- Total Blocking Time (TBT): Time during which the page is blocked from responding to user input.
- Cumulative Layout Shift (CLS): The number of unexpected page content changes after being rendered.

Page transfer size represents the data transferred to the browser as the page loads. We used the transfer size of all resources and the transfer size of image resources reported by Yellow Lab.

RESULTS AND DISCUSSION

Different optimization methods used to study the general performance for three websites. In Figure [3] (1) (2) (3) the compression between un optimized sites and optimized sites showed that the performance has Improved by 90.5% in most cases and remain the same in the other cases. The results suggest that the end users would notes the improvement of optimized sites in terms of peed compared with un optimized sites. However, subsequent investigation found that other

techniques are better appropriate for different places. Optimizilla was the least efficient for sites 1 and 2, since it was the only solution that did not enhance the Score, owing to insufficient support for deferring offscreen pictures and resizing huge images. For site 1, Joomla core resulted in a 4.5% increase in performance. The remainder of the approaches significantly enhanced site 1's performance. The best results were obtained by compressing JPEG and PNG images, which improved by 20.4%. The Score of site 1 was enhanced by 12.5% on average. For site 2, the Approaches JPEG-Optimizer and Compress JPEG & PNG images produced the best results, increasing the Score by 7.5% and 8.6%, respectively. Site 2's score increased by 3% on average. For site 3, all techniques yielded significantly superior results, with the Score improving as the page loaded in the browser.

Users utilized the total resource transfer size as well as the image resource transfer size as supplied by Yellow Lab. The KW test was used to explore further into the Performance Score. For all three sites, the hypothesis "Distribution of the Score is the same across all types of techniques" was rejected. In all pages, there was a statistically significant difference in result between optimized and unoptimized websites. For site 1 ($\chi^2(6)=33.701, p=0.000$), there was a significant difference in mean Scores for Image Recycle, EWWW Image Optimizer, and Compress JPEG & PNG images, with mean Scores of 92, 92, and 94.2, respectively.

Site 2 ($\chi^2(6)=21.105, p=0.000$) had a significant difference in JPEG-Optimizer with a mean Score of 97, and Compress JPEG & PNG images with a mean Score of 97.8 when compared to the unoptimized site. This is also valid for site 3 ($\chi^2(6)=21.105, p=0.000$), where JPEG-Optimizer, Compress JPEG & PNG images, and Joomla core all had statistically significant differences, with mean values of 99, 99.2, and 99.6, respectively. For all three sites, we saw that optimizing using Compress JPEG & PNG images increased the Score significantly. The amount of correlation between the ratings ($M=4.5, SD=0.23$) and the Score ($M=0.94, SD=0.06$) was next investigated. There was no association ($p=0.589$) between them, according to Spearman's rho analysis. Despite the lack of a link between performance and ratings, there was evidence that highly popular plugins, which were found to support more image optimization aspects through our analysis and comparison than plugins with very few active users, were also highly rated, indicating that users are satisfied with the features provided. The strong correlation between the ratings ($M=4.5, SD=0.23$) and the Score ($M=0.94, SD=0.06$) was observed.

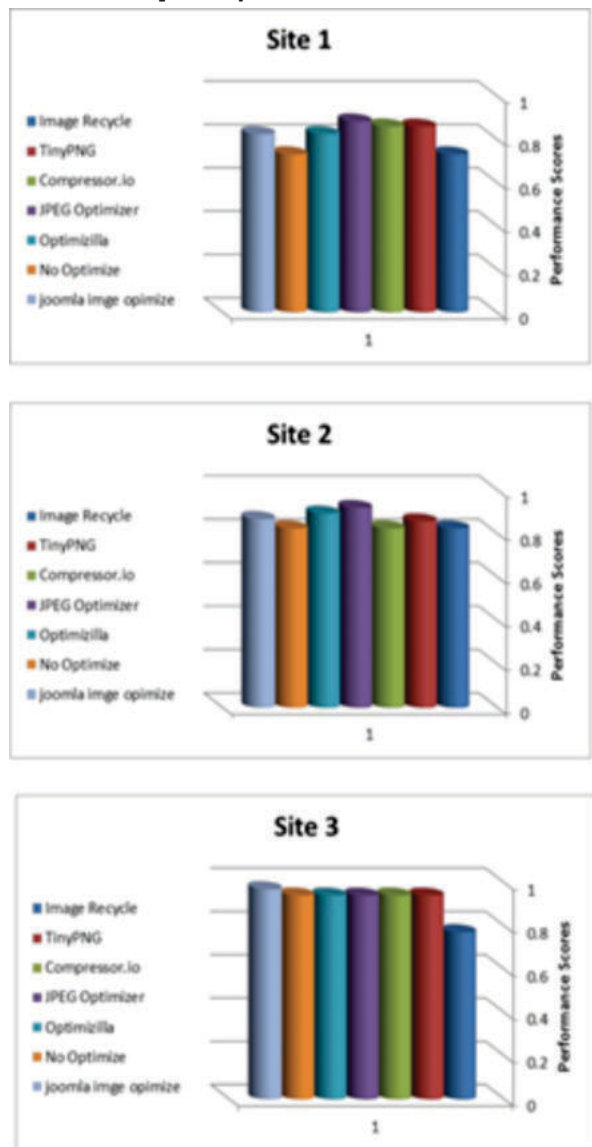


Figure 3: Performance Scores.

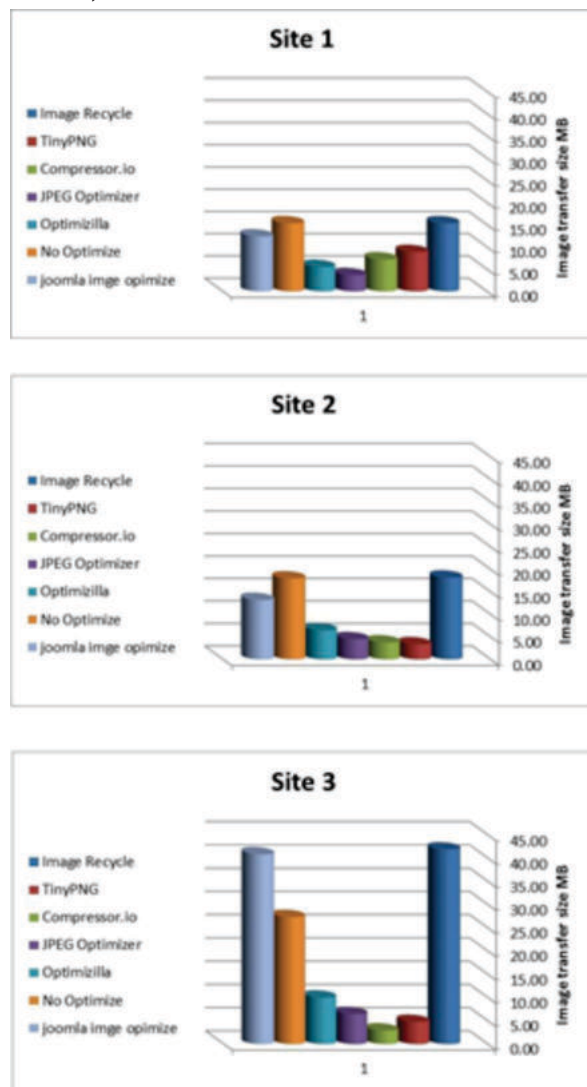


Figure 4: Image Transfer Size

Fig. 4 shows the sizes of image resources transported over the network for three websites improved using different optimization approaches. The findings reveal that the techniques reduced image size and, as a result, overall page size, with average image weight reductions of 41.9 percent, 53.8 percent, and 62.9% on sites 1, 2, and 3, respectively. Image Recycle and TinyPNG, in particular, techniques that

provide lazy loading with effective image compression, lowered the majority of the image transfer size on initial load. By evaluating only the file sizes of plugins, we can see that they vary significantly; Optimizilla has the lowest file size of 77.8 KB, while TinyPNG has the highest file size of 17.1 MB. To study this further, researchers investigated at how adding plugins to a site without optimizing it affected speed. The size of other resources may be determined by observing the differences between total transfer size and image transfer size. This reveals how many more assets are sent on page load, some as a result of the site design and others as a result of the optimization plug-ins themselves. Image Recycle increased the transfer size of overall page resources by 8.4 KB and TinyPNG by 12.3 KB, according to the data. When any automated image optimization technique was used, the performance results from load time and transfer size demonstrated that the performance increased. These findings are consistent with earlier research, emphasizing the importance of using image optimization on real websites. However, data imply that, because the techniques give variable levels of assistance for different optimization features, the optimization approach chosen should be based primarily on the site's and media content's characteristics (e.g., image formats, image dimensions, the number of images). For simple sites with a small number of images or images that are relatively small in terms of size, such as our prototype site 1, optimization with Joomla core is sufficient, especially given the evidence that plugin-based approaches frequently add additional weight to the site, whereas all image optimization features of Joomla core are built-in by default in the Joomla environment. For image-heavy sites, plugin-based techniques should be considered instead.

CONCLUSION

Images commonly contribute more of a site's overall size than HTML, stylesheets, fonts, script, and other resources put together. Un optimized images are often the source of needless bytes transmitted over the network to show a site in the user's browser, resulting in increased page size and response time, significantly impacting web performance. Reduced load times and improved speed are very important these days, since they affect user satisfaction, site usability, bounce rate, and even the site's rank in search results. Even with these problems, image optimization should be used. To get insight into the automated optimization of images in the Joomla context, a measurement-driven study was done. Three Joomla-powered sites were created that address common image-related issues found on the internet, such as images with metadata, images that aren't compressed well or at all, images that aren't in the most efficient format, images that aren't sized properly, and off-screen images that aren't deferred. To solve these concerns, the sites were improved using specified methodologies for automatic image optimization, and web performance was tested using Yellow Lab Tools using the metrics chosen. The findings show that image modification can provide significant benefits. While methods for image optimization differ (e.g., image compression, resizing, format conversion, lazy loading, and metadata removal), all have the ability to increase overall performance.

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