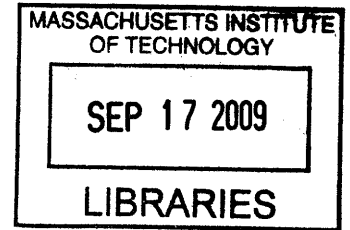


Trig'r:
Collective Perception of Architecture

by

Shih-Sang Chiu

Bachelor of Architecture
Carnegie Mellon University, 2005



Submitted to the Department of Architecture
in Partial Fulfillment of the Requirements for the Degree of

Master of Science in Architecture Studies
at the
Massachusetts Institute of Technology

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Abstract |

In recent years, the advanced development of the web and the increasing success of digital camera technology have led to an exponential growth in databases for web-based image sharing. The focus of this thesis is to research and propose a novel approach to enhance image browsing and exploration through collective collaboration. The research will result in a test-bed, called Trig'r, for issues related to the filtering and understanding of images with architecture-specific ontology on a photo-sharing website.

The core idea is to incorporate the principles of photography, data-mining and statistical analysis into a single tool that will leverage explicitly disclosed, user-related information in order to enable the user to understand the dynamics of architectural experience. By gathering the constantly changing user-directed images on the web and effectively structuring them for the use of architects, it offers a collaborative inquiry into the fundamentals of architectural design and experience through visual representation and textual description. The goal of this thesis is ultimately to provide a theoretical framework for a model that exploits the potentials of user-generated online visual metadata.

Thesis Advisor Terry Knight
Title Professor of Design and Computation

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CHAPTER ONE

Introduction |

1.1. Overview

The architectural design discipline, like any other discipline, is rooted in its history and builds upon it as it progresses forward in time. It develops critically based on observation of the past and intervention of the present. It at times foresees and suggests the future.

Architecture is living history. It is the world in which we live. Thus, the effects of architecture cannot pass unnoticed. Architects are constructing a world on the page and improvise on the stage. It is about making an impression on people as well as designing ways of interacting and engaging participation with the built environment. Architectural experience encapsulates the way we see, the way we feel, and the way we relate to the world.

In all stages of design, images are the most prominent tool to effectively communicate ideas. In general, still images serve as a universal language for design communication. They not only provide instant manifestation of conceptualization but also encrypt it with layers of information for further interpretation. Photographs are particularly powerful for representing the built environment and capturing physical attributes of any subject matter. A photograph is the evidence of physical presence and experience at a particular time in space.

There are many types of still images used to articulate and represent design, such as computer renderings, sketches and montages; however, photography is the only medium that enables us to access and understand architectural experience without being physically engaged. It allows us to travel in time and space. It particularly serves as a protocol, which grants us the opportunity to relive the past. We can easily project ourselves into the scenario and place by looking at a photograph.

Throughout the process of design practice, searching for and gathering images from the past and present allow us to envision the future. Photographs serve as a unique record of architectural and social history.

The web phenomenon makes global communication possible and accelerates information transit and delivery. Most importantly, bidirectional web communication leads to massive and overwhelming online storing and sharing of information. In principle, the web is essentially a collective database, collaboratively contributed to by people from all over the world. With a connection to the Internet, we can practically be anywhere at any point in time. Our actual physicality does not restrain us from retrieving information. As a result, media no longer has the full authority in controlling the propagation of information. The web delivers objective narrative to any subjective story told online.

Web technology increases the capacity to store and share images and information in real time online. In parallel to the development of the web, digital camera technology improves the quality of photography and makes digital photographs possible to share online. Moreover, the real-time visual database is expanding exponentially since the introduction of camera-mobile integrated technology. This thesis investigate what specific

conclusions we can draw about the types of photographs that are posted by the present community online, and how they can be utilized to inform architectural design and reflect the general public's understanding of and interest in architecture. It conveys the concept of a crowd-sourcing catalogue for architectural design.

1.2. Problem Statement

In the process of design research and concept development, effectively searching for and browsing images of the precedents enable designers to acquire insights into their task. Web services like Google and Yahoo not only grant us instant access to the large visual resources online but also give us a relatively unbiased measure of global interest in architecture. The perspective on architecture is unbiased in the sense that the exposure of information is not mainly media driven but conducted collectively by the online community.

The conventional architectural design process involves the architects learning from precedents, searching for ways to improve upon them, and finally proposing their vision for the future. To optimize this process, architects need feedback from the users to inform their design decisions.

Great architecture design inspires and moves people visually and spiritually. Photography is the medium we use to capture and record those moments of attention. A photograph is a choice of subject, composition and point of interest whether it serves as a sign of appreciation or resentment. The subject most certainly attracts the photographic eye; otherwise it would remain unnoticed and unphotographed.

By situating web and digital camera technology in the context of architecture, the architectural discipline benefits substantially from a design research point of view and most importantly, the global photographic representation of architecture reflects the collective perception of architecture.

Trig'r, the web-service proposed in this thesis, is implemented with the means of a *faceted-browser* and unique user interface designs. It has a threefold significance. First, it helps us to understand the complexity in images and how people use tags to index and associate specific architectural images. Secondly, it proposes frameworks that leverage user-directed content by structuring and prioritizing this unstructured and massive set of data available online, allowing users to visualize data statistically and trigger realizations within them. Lastly, it demonstrates the concept of sustainability in an architectural digital image repository. By introducing a system that allows users to contribute to it and benefit from maintaining it with quality inputs and feedback on photographic content, it highlights the importance of collective collaboration in the context of architectural design.

1.3. Purpose

Crowd-sourcing Principles for Architectural Design

The *Trig'r* search interface developed in this thesis aims to provide an exploratory and adaptable experience for its users to browse images posted online. It is also empowered by collaborative contribution. The primary design goal is to allow users to visualize architecture-related metadata effectively in a hybrid multidimensional. The beta test version of Trig'r uses a sample database from Flickr, currently the largest online photo management and sharing application in the world.

By explicitly exposing architectural-design related metadata, this thesis offers an alternative way to search for images online. This is an application that will greatly serve the architecture community worldwide. In the attempt to place user-generated visual data in the context of architecture, the design principles for a search interface are informed by the characteristic of architectural images and formal design theory. Thus, it makes the process of design research more meaningful, intuitive, informative and exploratory than the conventional way of browsing large images online. Inquiry into architectural design is fully formulated and developed through the act of searching. The conventional type of image searching does not offer a framework for understanding the content of the results. With the use of the proposed system, knowledge acquisition is fresh, efficient, effective, insightful, reflective, and sustainable.

The implementation of this thesis serves as an evaluation of the potential for adapting architectural design research to the web infrastructure and evolving along with it. The future of information exchange and communication lies within the development of the World Wide Web. Architectural design research must position itself parallel to web development in order to gain firsthand information.

1.4. Structure of Thesis

Chapter Two consists of background research on the four specific topics that this thesis covers. Topics include: (a) the development of architectural photography in relation to the introduction of digital camera technology, (b) the impact of the web phenomenon on the high demand for and reliance on digitized information, (c) the paradigm shift in knowledge building since the introduction of the web, and (d) precedents in

the field of data visualization.

Chapter Three introduces the system infrastructure of Trig'r. The first section presents an overview on the search interface design. It covers the designated framework and strategy for data visualization that is being deployed in the beta version of Trig'r. It includes descriptions of (a) the concept of Trig'r, (b) the proposed taxonomy that is used to classify and sort images, (c) the templates designed to enhance image browsing and understanding, and (d) the unique character of the user interface design. It also goes over the elaborated frameworks developed for Trig'r to cope with a mass tagging strategy. The second section uncovers the design specification and intention for the two modes of Trig'r, Explore and Matrix, in more detail. Topics focus on the browser implementation, data visualization strategy, and interaction.

Chapter Four presents the qualitative and quantitative analysis of the collected sample data from Flickr. The analysis and evaluation is conducted in three steps: (1) objective description of the usability of Trig'r and inquiry procedure from the designer's narratives, (2) subjective interpretation of the results and the process it takes to retrieve information from the user's point of view, and (3) summary of the analysis and evaluation for each mode of Trig'r.

The fifth chapter is the discussion of the thesis. It includes the major research discoveries and significant contribution of the proposed system. A section of critique is also presented to examine both the usability and the criteria for the proposed image search interface template.

Lastly, the sixth chapter discusses the outcome and contribution of the thesis and possible further implementation.

CHAPTER TWO

Background |

2.1. History of Architectural Photography

Architectural photography must capture the eye and imagination of the viewer and reflect the artistic vision and marketing needs of the designer. The details of the creation process are unimportant. All that matters is the impact of the final image delivered to the client. -Joe Aker¹

After nearly 170 years of achievement in architectural photography, the fundamental value and meaning of what a photograph represents have stayed relatively constant, but the shifts in photographic styles throughout its history have been greatly impacted by the development of camera technology, commercial enterprise and architectural industry as they advance in parallel.

So a key to style lies in the particular approach photographers make to their subjects and in the context within which they show them. And their work is energized by a sense of its connection to earlier or opposite bodies of work.²

This chapter briefly traces the history of architectural photography from the very beginning to the present. Each section investigates photographic characteristics that mark and

¹ Davis, J. (2002). Through the Lens: International Architectural Photographers. Images Publishing Group., 8

² Robinson, C. and J. Herschman (1987). Architecture Transformed: A History of the Photography of Buildings from 1839 to the Present, Architectural League of New York.

shape the relationship between architecture and photography.

2.1.1. Defining Subject Matter

From 1839 to 1880, the early days of photography, architecture served as an ideal subject matter due to its static and complicated nature. Photography was able to capture and represent fine details and precise proportions of a building and its craftsmanship. In addition to traditional architectural representations, such as hand renderings and sketches, photography became evidence of architectural live rendering. This era marked the establishment of “the elevation,” “the perspective,” and “the bird’s eye” in architectural photography as an extension of architectural rendering.

The architectural rendering techniques of elevation and perspective were developed with superior draftsmanship to serve as a tool to illustrate detail as fine as possible. An elevation is essentially a two-dimensional rendering while perspective embraces the three-dimensional characteristics of the reality. Unsurprisingly, architectural photography was first used as an additional medium to illustrate architecture grounded in the same principles.

New forms of rendering developed. The aerial, or bird’s eye, view is one of the era’s most popular ways of depicting buildings and the urban fabric. This type of photography gives the viewer a grand vision of the subject in relationship to its location in the city and also to its immediate surroundings.

Architectural photographs produced during this era were composed with a more, formal, straightforward and refined approach. Composition tended to follow the same fashion as stand-alone portraiture. A photographer would make apparent

his/her opinions by what he/she chose to include and omit in his/her photographs. The narrative of each photo was delivered through the clear photographic composition instead of radical camera angles or perspectives.

2.1.2. Controlled Photography

Starting from around 1880, the style of architectural photography moved away from the factual style of the early years to a more segmented and expressive style. In contrast to the factual style of architectural photography, which informed the viewers like an architectural drawing to scale would have, segmented photos offered strong impressions on plastic characteristics of buildings to the viewers.

Given a collection of abstract and segmented photos of a building, viewers could reconstruct the appearance of building from looking at them but with no understanding of how the building functioned.

The style began with building portraits. The buildings stand free and whole, taken from an objective distance, directed towards the building, isolated from its surroundings but including just enough from either or both sides of the photograph to give a sense of unbiased completeness.

As technology advanced, increases in emulsion speed made it possible to capture human presence and experience as a part of the composition and narratives. The posed people in architectural photography not only serve to symbolically celebrate the technology of its time but also to provoke dialogues between the viewer and the photographer. It puts emphasis on the experience of the architecture rather than on glorifying the architecture.

Between 1910 and 1930, travel photography by architects, with

their experiential and artistic approach to architectural photography, was the dominant style. Architects such as Le Corbusier often included subjects such as cars in the photograph to suggest a sense of modernity and functionalism as part of conveying his design approaches.

2.1.3. Branding Through Photography

The belief that people were central arose from the 1950s answer to a question that had been important to the 1930s, which was whether one could record one's experience or only learn how things looked in photographs. Could a photographer show people unaffected by the camera (candidly) or at best simply line them up for their pictures?³

The fundamental purpose of architectural photography is to communicate through visual description and expression with those who have not seen the building. The role of the architectural photographer is to honestly represent the space under the illumination of light. On the other hand, it is a quick, convenient, and effective tool for architects to conceal the truth of their design from those who have not yet been to the space. Branding architecture through manipulated photographs quickly became a common tactic in the architectural industry to get away with poor design quality.

Furthermore, the act of taking a photograph is an act of transforming, not simply recording. How can one strategically translate a three-dimensional spatial experience onto a two-dimensional still image? The composition sets the stage for the viewers to travel through space as their eyes follow the animated traces of light within the image. Often, there was a collaborative relationship between the architect and the photographer.

³ Ibid., 2., 67

2.1.4. Introduction to Color and Digital Photography

The photographic representation of architecture has finally become universally autonomous. Architecture takes a peripheral role to the inhabitant activity in and around it. It is the movement and life that produces the dynamic of the image. The juxtaposition of this movement with the static framework of architecture results in the captured still image of unchoreographed reality. - Bitter+Bredt ⁴

With the introduction of color photography in the 1960s and digital photography later, the focus of architectural photography became less clear and diverged. As color diffuses and distracts the attention, photographers focused on the interplay between light and architectural space in photography. At the same time, color is an important feature of architectural design because it adds another dimension to the overall character of a building. Color sometimes is descriptive of form and light. For a while, people were more interested in how they photographed a building than what they were photographing.

2.1.5. Emergent Images in Public Domain

I respond to two challenges when photographing architecture. One is faithfully rendering the architect's vision; understanding a building's personality and essence. The other is finding something in the essence of the structure that is not immediate to the eye, getting under the skin and reinterpreting the form. Creating images that make us look again at that which we might otherwise take for granted. - Simmonds Photography ⁵

Photographs make us aware of and visually reflect upon the built world we live in, allowing us to make connections and observations that would not have been obvious otherwise. A

⁴ *ibid.*, 1., 24

⁵ *Ibid.*, 1., 202

collection of photographs of a particular place tells the story of the way it is designed to be experienced.

In a sense photography engages the viewers through illusion, presenting a range of complex information about a building, but this two-dimensional medium is an observation quite unlike the knowledge of personal experience. It has the capacity to trigger great interest in the work and further investigation in seeking out the original. - Trevor Mein⁶

As a result of the successful web development, web-services such as Flickr or Picasa offers us the opportunity to share photographs (refer to Section 2.2. for more detailed description). It allows us to instantly exchange visual information about architecture and the world around us. It is a thought-provoking and visual dialogue between viewers and the photographers as they browse through images. Well-captured images have the power to make people ponder for a moment and wonder about the space.

What is it that you see and we don't? The culture of Web 2.0 (see Section 2.2.) is to fight for uniqueness and fight to be different and controversial. The culture of Web 2.0 is to tell us what you know but we don't. It is the sharing of knowledge and findings to provoke communication and thought exchange.

First it was a battle, and then gradually I realized that I just needed to enjoy the space to take a good picture. Understanding the relationship between architecture and me expands my horizon. I try to deliver a sense of its space and the feeling of its materials as I see them. - Katsuhisa Kida⁷

The massive number of online photos today is overwhelming; however, it is also good because it demands creativity to be articulated and expressed. Some spatial quality triggers the

⁶ Ibid., 1., 160

⁷ Ibid., 1., 112

photographic eye simply because the photographer enjoys the space regardless of the richness of the subject matter.

2.2. Web Phenomenon

2.2.1. Web 2.0: Bi-directional Web Technology

Web 2.0 refers to the second generation of web development and design, which facilitates communication, secure information sharing, interoperability, and collaboration on the World Wide Web.⁸ It is revolutionary in the ways it lets software developers and end-users utilize the Web. They treat the Web as a platform and build their applications upon it. As a result, there has been a rapid growth of web-based community, web-hosted services, and applications such as social networking sites, video-sharing sites, wikis, blogs, mashups and folksonomies since the introduction of Web 2.0.

The core ideas and values that emerge from the Web 2.0 approach to the World Wide Web are the various forms of idea sharing through the use of texts, images, videos and more. Up till today, the development of Web 2.0 has encouraged users to participate in content creation on social networks, blogs, wikis, and media-sharing sites. It is a platform open for the community to collaborate and to create values on any subject and on any scale. A few of the best-known examples that illustrate the essence of Web 2.0 are Google, Yahoo, Amazon and eBay. These service providers typically include most of the following features: searches, links, authoring, tags, and extensions signaling.⁹ These features extend the users' ability to go beyond

⁸ Wikipedia, the free encyclopedia webpage, http://en.wikipedia.org/wiki/Web_2.0, [Accessed July 28, 2009]

⁹ Andrew, P. (2006). "Enterprise 2.0: The Dawn of Emergent Collaboration." MIT Sloan Management Review.

the traditional interaction techniques with data in Web 1.0.

Another common feature of Web 2.0 sites is the development of Web APIs (application programming interface). When API is used in the context of web development, it is an interface that allows the users to request services from online libraries, databases or operation systems. An API determines the vocabulary and calling conventions that the programmer needs to use in order to request services from the provider of the web-service and it can be written in many different programming languages.¹⁰ It permits the end-users web-based access to data through machine-based interaction.

Furthermore, one major characteristic of user-generated content is the metadata regarding it. Metadata can be simply described as “high-level data”¹¹ It is the type of data that provides the context for data. It is also used to encapsulate the characteristics of a particular data type from all aspects for complete description. On Ebay, where the data is the content of items on sale, metadata about an item would most likely include a description of the content, the seller, the price, the day the sale begins and ends, and the shipping cost. If we take a photograph posted online as an example, the metadata may include the date and time at which it was taken, the model of the camera, and the camera setting. Most digital cameras nowadays record data information in EXIF (exchangeable image file format) and the level of details depends on the type of digital camera used.

Prior to the development of Web 2.0, Web 1.0 seemed more one-sided in terms of its controlled sources and controlled

¹⁰ Free On-Line Dictionary of Computing
<http://foldoc.org/Application+Program+Interface>, [Accessed, July 28, 2009]

¹¹Wikipedia, the free encyclopedia webpage,
<http://en.wikipedia.org/wiki/Metadata>, [Accessed July 28, 2009]

distribution of content. Flickr¹², one of the biggest photo-sharing web-services available today, emphasizes the following features: (1) a collaborative user interface that allows users to post, share, tag, blog, and comment on their and others' photographs, (2) an open source elaborated API to its current available content, (3) a foundation based on the concept of social networks for people who are interested in viewing photographs and/or photographing, and wish to harness the essence of sharing and exchanging perspectives to create value from their collaboratively contributed content, and (4) a search interface that is particularly designed to address its site's essential concepts. For example, you are granted the options to refine your search to a collection that belongs to a certain category of interests or a certain type of camera model or a certain physical location of the community or many more.

2.3. Web Search Engine: Knowledge Building

As the term web search engine suggests, it is a tool designed to search for information on the World Wide Web. Typically, a web user defines a search query by inserting it as a series of text strings into the query field as part of the search engine, and a list of relevant results is returned. The types of results may include web pages, images, videos, maps, news, reviews and all types of information in any digital media format that is related to the search query.

Undoubtedly, with the rapid growth of information available online today and the convenience of accessing the Internet, the Web has become the main source of information when we seek answers to our questions on a daily basis. We no longer turn to a

¹² Flickr
<http://www.flickr.com/>, [Accessed July 28, 2009]

library and look for physical copies of information (books); rather we turn to one of the biggest web information providers, such as Google or Yahoo, to request references. The ways we approach information and retrieve information play a big part in how we construct knowledge subconsciously.

Besides the keyword search paradigm that we are all familiar with today from using Google and Yahoo, there are also many other possible ways we can search for information. In the following sections, different types of search engines will be presented. Each type of search engine will be listed with the features it offers to its users for retrieving information.

2.3.1. Keyword vs. Faceted

Web search engines are primarily built upon the information they retrieve and store from the WWW. The content of each page is analyzed and indexed algorithmically. The web pages are indexed in many ways. Indexing could be performed based on extracting words from the description of the page, title of the page, or titles of the images set within the body of the text, headings, subheadings, or special fields called meta tags, and various other ways.¹³ The information regarding the content of the page is called upon to link back to the page when a matching indexed query is placed into the search engine.

Keyword searching is the most common way to search for information online. Your inputs, in the form of a question or multiple words as the search query, will be used to match against the indexed information that is available in the database. And to improve the results, you typically have the options to refine your

¹³ Search Engine History
<http://www.searchenginehistory.com>, [Accessed July 28, 2009]

search by using an “advanced search” page that restricts the return results to an even more specific domain such as a particular type of file format or language. A typical keyword search will return a list of ranked information.

Unlike keyword searching, a faceted search (see Section 2.3.3. for detailed description) enables the searcher to explore a domain through its attributes in a dynamically structured way. The results that it returns give you the overall scope of the search query you are posing. In a library, one can easily understand the subject of the book by comparing books on the adjacent shelves with a glance. You can get a sense of the subject by the cluster of subjects.¹⁴ In the following section, works related to this thesis will be listed and illustrated.

2.3.2. Examples of Image Search Engine

Google

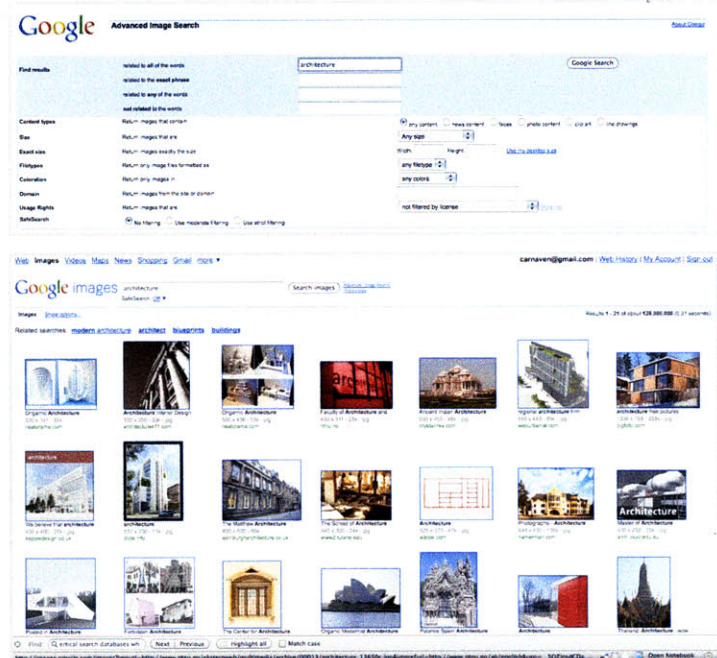


Figure 2-1
Screen shots of the web page for Google. The upper image demonstrates the Advanced Image Search Mode and the lower image demonstrates the default settings of Image Search.

¹⁴ <http://nopain2.org/archives/000123.html>, [Accessed July 28, 2009]

Google¹⁵ is currently the biggest and most-used search engine available online. Google's image search provides many options for customized advanced search (see above figure), such as custom fill-in fields for current type, size, filetype, usage rights, domain or site. The search results are listed in a priority-order. Its custom feature allows users to search for images within a certain site, such as Flickr, while remaining in its generic search interface.

PicSearch

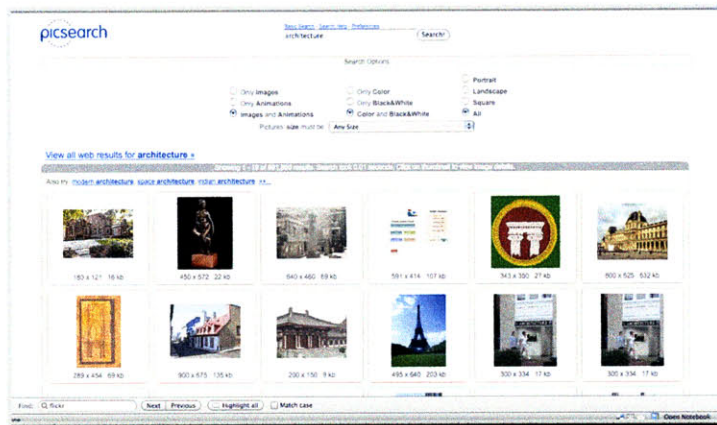


Figure 2-2
Screen shot of the web page for PicSearch in Advanced Search Mode.

Picsearch¹⁶ is another well-known image search website that was developed by a Swedish company which develops and provides image, video, and audio search for large websites. It provides the users with a list of recommended search topics related to the initial one. Advance search features for refining search-results include media type (image and/or animation), color (color and/or black & white), and image layout such as portrait, landscape, or square. Again, the advanced search features don't offer any insights into the structure or character of the content but merely the best-indexed results retrieved from the database.

¹⁵ Google
<http://nopain2.org/archives/000123.html>, [Accessed July 28, 2009]

¹⁶ Picsearch
<http://www.picsearch.com>, [Accessed July 28, 2009]

2.3.3. Faceted Search

iTunes

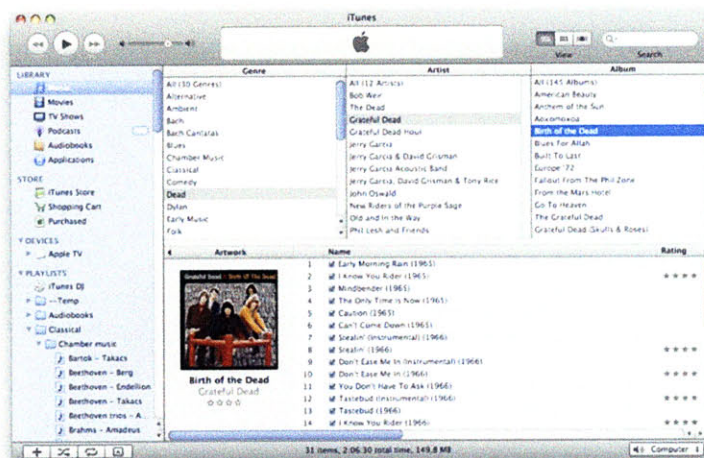


Figure 2-3
Screen shot of the browser for
the Mac software iTunes.

The iTunes browser is an example of a faceted navigation where the users can review a music-playlist or music item in three properties/facets: genre, artist and album. Tracks are organized and categorized based on these three properties. Users have the flexibility to search for related tracks based on a given genre or artist and the available content then will be listed. In Figure 2-3, there are three columns positioned at the upper portion of the iTunes explorer. The overall hierarchical order of information goes from genre to artist, then to album, and they are arranged from left to right. Each column is designed to hold attributes for each the three properties. Search results are returned in the lower section of the browser.

Relation Browser

The Relation Browser project¹⁷ is led by Gary Marchionini at the University of North Carolina. A faceted browser that has made particular use of representing quantity is the RB++ browser, which is also known as Relation Browser++ or RAVE.

¹⁷ Zhang, J., T. Shearer, et al. (2004). Relation browser++: an information exploration and searching tool. Digital Government Society of North America.

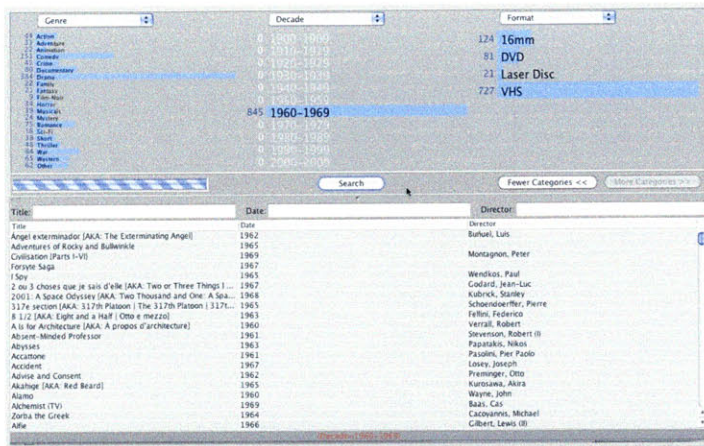


Figure 2-4
Screen shot of the web page for Relation Browser. An ongoing research project designed and hosted by the Interaction Design Laboratory at UNC Chapel Hill.

This type of browser is particularly statically informative. It enables the users to visually see the collection of information quantitatively as they refine search parameters. An enhancing key feature about RB++ browser is the histogram bars shown against each of the attributes listed for each property/facet. The histogram bar represents how much available content there is for that attribute in respect to the total amount in the property/facet or to each attribute in that category relatively, depending on how the RB++ browser is set up for interaction. Then if an attribute is selected under a property/facet, other attributes will synchronize and update the current results that are associated with that selected attribute.

Flamenco Fine Arts Search

The Flamenco project¹⁸ is led by Marti Hearst at the University of California, Berkeley. The Flamenco search interface framework has the primary design goal of allowing users to move through large information spaces in a flexible manner without feeling lost. It is similar to the techniques implemented with Trig'r proposed in this thesis, guiding the users towards possible choices without the hassle of repetitively entering and modifying search queries. This interface design permits the user

¹⁸ Hearst, M., A. Elliott, et al. (2002). "Finding the flow in web site search." *Communications of the ACM* 45(9): 42-49.

to retrieve information with an uninterrupted flow by a simple and continuous motion of the mouse clicking on links.

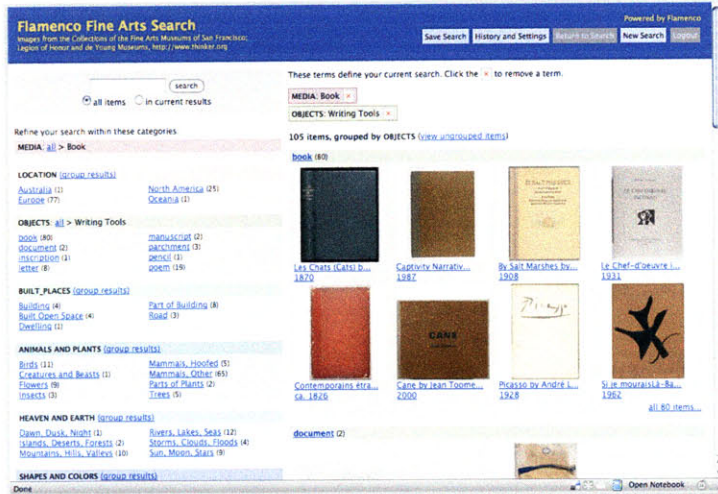


Figure 2-5
Screen shot of the web page for
Flamenco Fine Arts Search.

2.3.4. Flickr Search Interface

Flickr is a social media platform for people to share images and video online. It follows the template of the Google search engine, providing keyword searching, having been developed to demonstrate the beauty and characteristics of Web 2.0.

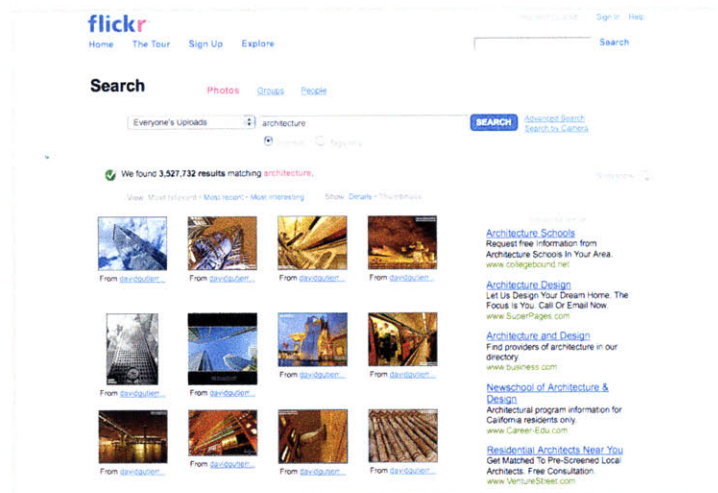


Figure 2-6
Screen shot of the web page for
Flickr. The collection of
thumbnails displayed at the
bottom of the page presents
partial results of the search
“architecture.”

Its search engine is designed to give its audience diverse perspectives on the content by providing filters for the users to

search for photos posted for a distinct focus of interest. The user can search for the tag or the text related to the photos while applying filters to return results within a particular group of people who share common interests. Advanced search features include: search by content type, search by media type, search by date (photo taken date, posted date with before and after query field to be specified), and image license type.

2.4. Related Works

Web 2.0 is an interactive engaging platform for users to receive and generate online content in real time. The information exchange process between the web service and end-users is responsive, dynamic and fast. As a result, the approaches to visualize data have become even more expressive, descriptive and evolutionary. When we think about visualizing data, conventionally we would use tables, histograms, pie charts and bar graphs. This approach is rather out-dated for the fast development of Web 2.0. Data visualization strategies in this decade aim to encapsulate and manipulate with the properties of real-time data and effectively convey a clear message to the viewers.

Photosynth

In simple terms, Photosynth allows you to take a bunch of photos of the same scene or object and automatically stitch them all together into one big interactive 3D viewing experience that you can share with anyone on the web.¹⁹

Photosynth technology developed by Microsoft is groundbreaking for enabling users to navigate through complex

¹⁹Photosynth
<http://photosynth.net/about.aspx>, [Accessed July 28, 2009]

visual-scapes of the 3D world reconstructed from flat photos. It is a technology empowered by the web user-generated contents and it pioneered the use of photogrammetry to power a cinematic and immersive experience. Details of the physical world are revealed beautifully when users zoom into scenes and pan around.

Figure 2-7
Screen shot of the web page for
Photosynth, Microsoft.



Photo Tourism

Inspiration for the development of Photosynth, Photo Tourism²⁰ is a joint project between Microsoft Research and the University of Washington in an attempt to develop a system for browsing large collections of photographs in 3D. The system takes advantage of the large amount of data available online from photo-sharing sites or from personal collections. Then it automatically computes the viewpoint of each photograph and parses those viewpoints on the scene to construct an abstract 3D model of it. The photo explorer interface also allows the viewers to interact smoothly between photos in the 3D space.

²⁰ Snavely, N., S. Seitz, et al. (2006). Photo tourism: exploring photo collections in 3D. ACM New York, NY, USA.

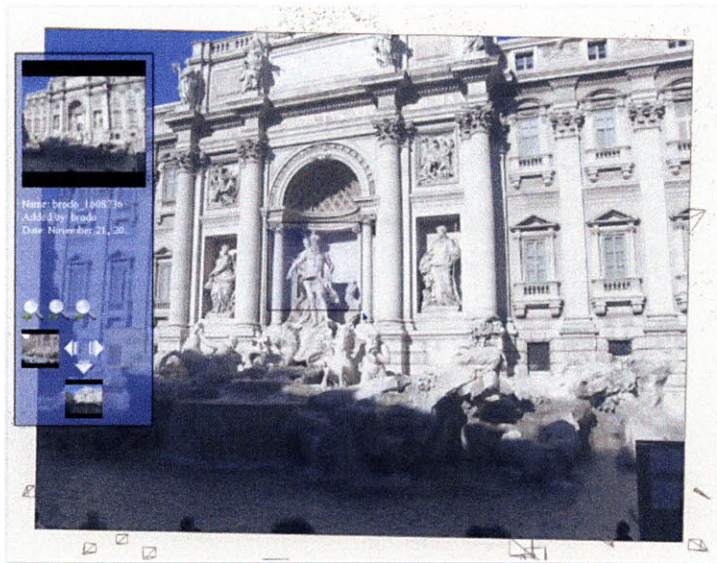


Figure 2-8
Screen shot of the demo video clip for Photo Tourism.

The World's Eyes



Figure 2-9
Screen shot of the web page for The World's Eyes.

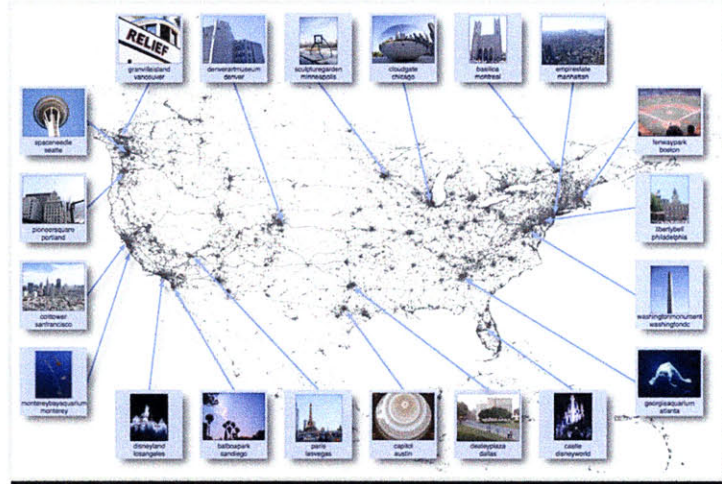
Los Ojos Del Mundo / The World's Eyes²¹ is a project initiated at MIT SENSEable City Lab in an attempt to understand the dynamics of tourism in Spain through strategically data-mining user-generated contents on Flickr. Enhanced with visualization techniques, it uncovers the evolutions of the presence and flows of tourists. The analysis and mapping of this data allows understanding of the attractiveness of leisure cities and their

²¹ Girardin, F., F. Calabrese, et al. (2008). "Digital footprinting: Uncovering tourists with user-generated content." *IEEE Pervasive Computing* 7(4): 36-43.

points of interest.

Mapping the World's Photos

Figure 2-10
Representative images for the top
landmark in each of the top 20
North American cities. All parts of
the figure, including images, textual
labels and the map itself, were
produced automatically from the
researchers' geo-tagged photos.
(Image: David Crandall)



Mapping the World's Photos²² is another Flickr-related research project developed by members of the Department of Computer Science at Cornell University. They investigate how to organize a large collection of geotagged photos. The project used a sample Flickr database of about 35 million images. In conjunction with analyzing images based on text, tag and image data, they also apply structural analysis techniques based on geospatial data. Through the process of demonstrating the techniques they developed to organize a large photo collection, they discovered various interesting properties and characteristics of popular cities and landmarks at a global scale.

²² Crandall, D., L. Backstrom, et al. (2009). Mapping the world's photos. ACM New York, NY, USA.

CHAPTER THREE

System Infrastructure |

3.1. Trig'r

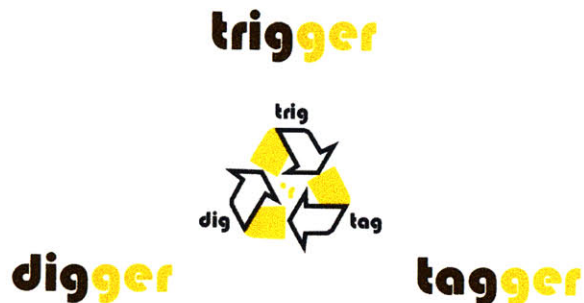
Figure 3-1
Logo designed for Trig'r
Trig'r pronounced as trigger. Its
goal is to trigger emergent
perception of architectural
experience and understanding of
design through image browsing



Trig'r is a web-service that utilizes an online user-generated visual database for the purpose of inquiring into architectural design principles and understanding perspectives of architectural design. Trig'r is designed as a template for refining and structuring visually based resources for learning and for finding design pattern inspiration. The user can effectively browse through images to see design trends with fresh content available on Flickr.

3.1.1. What Is Trig'r?

Figure 3-2
Trig'r is designed to set on top of
any open API visual database
and effectively structure the data.
It is a system that relies on the
collective collaboration among
triggers (photographers who
share their photos digitally),
taggers (those who tag their data
meaningfully), and diggers
(those who seek for architectural
knowledge from online visual
database.



Trig'r is a search interface for exploring architecture phenomenology through user-generated content on the web. It is primarily developed to provide a framework for filtering and structuring any online visual database that is built with user-directed metadata. The beta test version of Trig'r uses the sample database from Flickr, currently the largest online photo management and sharing application in the world. Apart from typical architectural images found in stock photo collections and official publications, Flickr images are neutral in the sense that they are distributed online and so are less likely to serve as advertisements or promotions as a part of a political or commercial enterprise.

Trig'r's main purpose is to be shared and to inspire members among the Flickr community with special interests in architecture and design. The user-generated visual database offers a fresh look into the experience and architectural interest from the user's perspective. The essential purpose of this application is to explore the architectural design discipline from a collective perspective and/or to acquire information about our built environment and architectural pieces in parallel. With its unique source of images and system design, it ultimately offers insights into the effect of architecture on people.

Moreover, with Trig'r, architecture enthusiasts and hobbyists can quickly grasp the fundamental elements of architectural design through browsing the real-time user-generated visual database. For professionals, Trig'r aims to inspire designers and enhance current design processes by introducing the user's preferences and interests to it. There are two browsing modes Trig'r users can choose from: Explore and Matrix. Explore enables users to understand the overall scope of the subject they are researching. And to further explore the initial subject and subjects with similar and/or common properties, Matrix enables users to

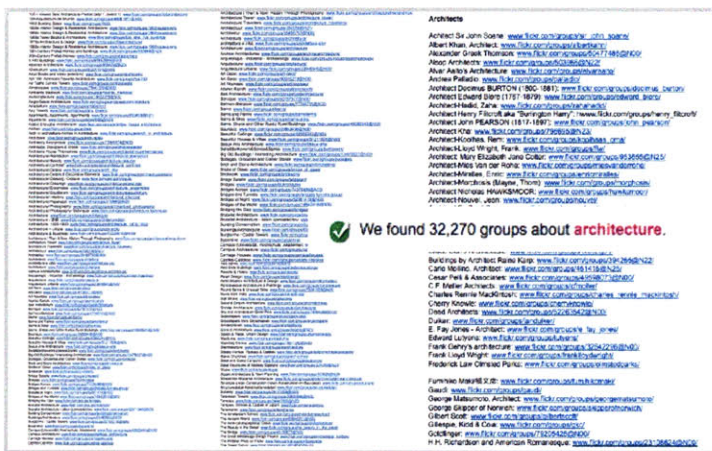
quickly compare similar results.

Trig'r is designed to be maintained by its members and their inputs. The core of Trig'r consists of three components: sharing of images, contributing to qualitative tags and encouraging interest in architecture. It is a test-bed designed to enhance image browsing and exploration through collective collaboration.

3.1.2. System Framework Overview

Trig'r is a search interface that is developed to structure the unstructured architectural-related metadata that belongs to online posted images, such as Flickr photos. To do so, its deployment incorporates principles of architectural design, photography, data-mining and statistical analysis. Its approach is grounded in the theory of architectural representation, perception and technology.

Figure 3-3
Screen shot of the Flickr page
with a list of groups formed to
share interest in architecture



As previously mentioned, the beta version of Trig'r is developed with a sample database from Flickr, a social-network web community, which focuses on the interest of photography and a wide interest of architecture among its members. Presently, there are 33,697 architecture-specific groups formed by its members,

which are, with a member count ranging from 10 to 30,115, varied for each group. The full spectrum of architectural topics covered by the members is as general as “architecture” or “amazing architecture” or as specific as “decorative elements of Russian architecture.” This further emphasizes the critical relationship between photography and architecture; photography is a powerful tool to investigate architectural design from overall form to details of construction.

Flickr API allows Trig’r to fetch images from its database and further categorize and utilize them by filtering the metadata every Flickr image comes with. Unlike other images found online, every Flickr image has additional user-directed information attached to it, such as the title of the photograph, description, author information, comments from other members, camera used to photograph, geolocation, photo taken date, tags and a rapidly growing size of other user- or photo-related information in conjunction with social network approaches.

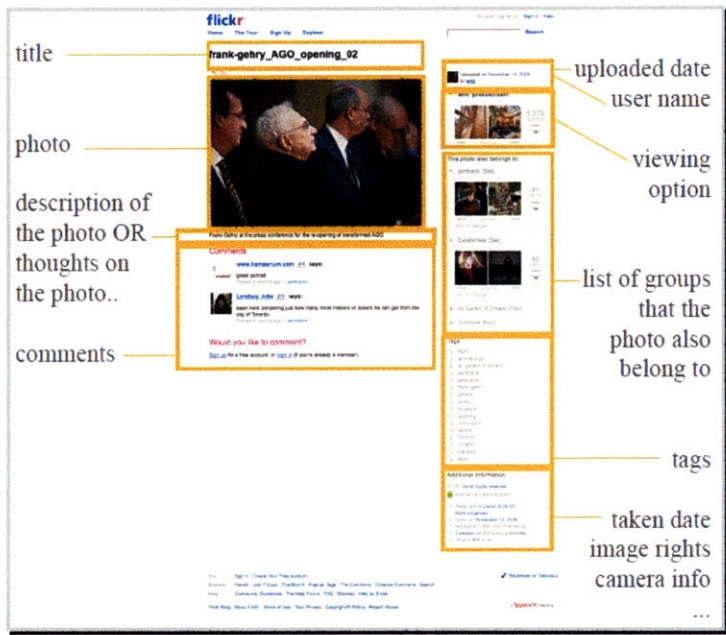


Figure 3-4
Screen shot of a sample Flickr page with labels for all available contents on the page. This demonstrates the preliminary scope of metadata that belongs to every Flickr photo and that is open to the users.

In online computer system terminology, a tag is a non-hierarchical keyword or term assigned to a piece of information

(such as an Internet bookmark, digital image, or computer file). This kind of metadata helps describe an item and allows it to be found again by browsing or searching. Tags are chosen informally and personally by the item's creator or by its viewer, depending on the system.

Tagging was popularized by websites associated with Web 2.0 (see Chapter 2) and is an important feature of many Web 2.0 services (such as wikipedia.com). This version of Trig'r mainly utilizes tags for its basic framework as the first attempt to effectively structure such an inconsistent data format contributed by users.

Tags are especially ideal when it comes to describing a photograph. Any photograph has multiple meanings and concepts embedded in it. A set of tags generated by the photo creator not only sets the photograph in its context, but also can extend and/or channel that information as the photo creator or any member in the Flickr community chooses.

The following section is divided into four parts explaining the system infrastructure of Trig'r in more depth. It covers the data-mining steps Trig'r takes to classify tags and to choose criteria for the framework of image browsing. The methods place the focus and consideration on how photographic data is understood from a set of given tags. They are designed to reconcile current deployment of tagging strategies in order to enhance the process of photo browsing. Methods described in the section unroll in the following sequence: mass tagging strategy, contextual tagging, automated tagging, and finally data visualization strategy.

3.1.3. Description of System Infrastructure

Contextual Tagging: Tagged by Flickr User, Tagged by Trig'r User While Browsing

User-generated tags are typically irregular in format and style. They depend heavily on the personal preference and background of the creator. In Flickr, for example, authors post pictures they take and label them with descriptive words they choose to associate the pictures with. You may tag a picture of your dog with "Chocolate," "backyard," "Dad," and "Frisbee." Those words enable you to quickly search for this shot of your dog named Chocolate playing Frisbee with your dad in the backyard from your large collection of Flickr photos. Tags are primarily generated for the convenience of the creators to retrieve their digital material stored online, not necessarily as a tool to categorize information. In addition, you have the option to make your digital content available for others to browse and place their preferred tags for their future search convenience. Unlike systematically filing and classifying material in a library, there can be as many as 75 tags used to label a single Flickr image in a rather casual fashion if it means to repeat a tag with equivalent meaning in 75 different languages.

Turning Folksonomy into Taxonomy

Since there is such a high demand and population in browsing and sharing architectural photographs in Flickr, researching how those images are tagged particularly for this group of interest became vital. Examining and exploring an enormous collection of tags that belong to architectural photos posted within Flickr architectural groups showed a clear pattern to words most frequently used to describe every particular concept. There are emergent non-standard taxonomic terms (non-dictionary-

standard synonyms) generated to categorize architectural information as a result of accumulative folksonomic usage.

The designed Trig'r template was specifically composed for categorizing architectural design terminology that would most benefit from photographic representation. It intends to unfold architectural design from superficial attributes such as construction material or spatial qualities, and perhaps even sensory and perceptual expression. Trig'r treats any given photographic representation of a building as an entity that comprises seven major properties. There is a list of attributes belonging to each property.

These seven properties are originally selected to offer user a comprehensive scope and understanding of the subject, such as a building. The seven properties implemented by Trig'r for image browsing are the following:

<i>Architect</i>	frank_gehry, herzog_de_meuron, santiago_calatrava, norman_foster, le_corbusier, tadao_ando, renzo_piano, mies_van_der_rohe, jean_nouvel, im_pei, zaha_hadid, louis_kahn, toyo_ito
<i>Building Type</i>	house, museum, commercial, transit_hub, bridge, park, cathedral, skyscraper, church, institution, plaza
<i>Exterior</i>	building_portrait, detail, access, surrounding, roof, circulation, under_construction, portrait, postcard
<i>Interior</i>	exhibition, space, event, detail, circulation, portrait, viewout, furniture, postcard
<i>Material</i>	masonry, metal, glass, stone, wood, plastic, fabric, asphalt
<i>Color</i>	color, green, blue, orange, gold, gray, black_and_white, yellow, red, silver, purple
<i>Impression</i>	splendid, simple, abandoned, dark, cold, peaceful, inspiring

The number of attributes contained in each property varies and they are partially determined based on how extensive the current available photos are that correspond to those attributes from Flickr database. Attributes that acquire the samples with the best quality and quantity were selected. They are a result of the contents of that architectural design classification.

Automated Tagging: Identifying Most-Frequently-Used Existing Tags and Matching Them Against Trig'r's Template

The list of attributes for each property is composed and selected from existing user-generated Flickr tags. Trig'r attempts to identify the existing set of collectively user-generated synonyms for each attribute listed in order to obtain the best image search results in terms of both quality and quantity. The procedure to identify tags for fetching Flickr photos is listed below. Each attribute is assigned a value, which is equivalent to the content a tag represents.

1. Identify attribute value/content
2. Identify variant tags (see Figure 3-5 for description) according to 1.
3. Identify most associated/relevant tags according to 1.
4. Evaluate search results of 3.
5. Filter out tags with most irrelevant results and add the remaining tags to 1.
6. Consolidate, refine and identify the final set of tags for each attribute

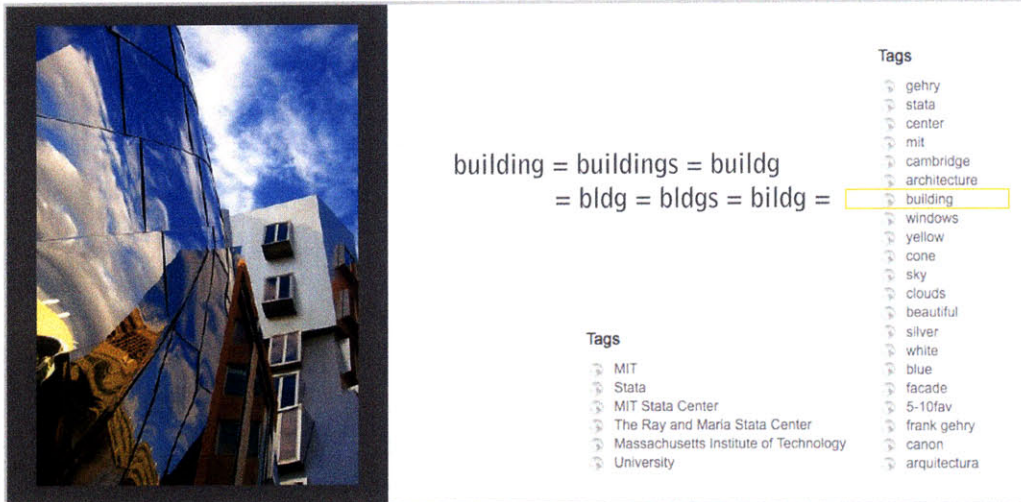


Figure 3-5 Variants most frequently used to describe building. The way people use tags online is similar to the way we use memos, Post-it notes or bookmarks. Variant tags are typically equivalent in meaning but different in spelling.

The resulting selection of architectural design elements defined as facets are those that can be effectively illustrated via photographic representation. With the same approach as how the categories are defined, each facet of the category is defined by a collection of variant spellings of the same tag. For example, photos of a building, architectural circulation, interior space and elements are most frequently tagged with the following listed respectively:

- building* ['bldg', 'buildings', 'building', 'blg', 'buildgs'...]
- circulation* ['stairways', 'stairway', 'stair', 'stairs', 'staircase', 'steps'...]
- interior* ['interior', 'indoor', 'indoors', 'inside'...]
- furniture* ['furniture', 'filing', 'seating', 'reading', 'cabinet', 'fixtures', 'sofa', 'couch', 'table',...]

The process of identifying the most associated tags for a particular tag or building becomes even more intricate than simply identifying variants due to the nature of user-generated content.

Frank Gehry {‘frankgehry’, ‘gehrypartner’, ‘gehryarchitecture’, ‘fgarchitecture’ [‘frank’, ‘gehry’], [‘gehry’, ‘architecture’]...}

Bilbao Guggenheim Museum {‘bilbao’, ‘guggenheim’, ‘bilbaoguggenheim’, ‘guggenheimbilbao’, ‘bilaomuseum’...}

Two identical images posted on Flickr may yield different collections of tags due to the dynamics of user background and methods of sorting information. Take a Flickr photo of the De Young Museum for example. The collection of tags generated for the Figure 3-6 photo is listed as follows:

architecture, building, california, deyoung, deyoungmuseum, goldengatepark, outdoor, museum, green, park, sf, shapeshift, tower, trees, usa, splendid, sony DSC-H1, DSC-H1, sony, sanfrancisco, herzogdemeuron, copper

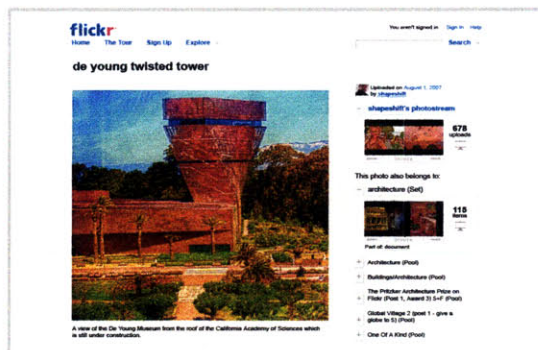


Figure 3-6
Flickr image of the De Young
Museum designed by Herzog &
de Meuron in San Francisco,
USA.

The information Trig’r extracts from this collection of tags for example would be as follows:

Flickr Group	Architecture
Classification	Tags
Context	architecture, building
Architect	herzogdemeuron
Building type	museum, park
Exterior	outdoor
Material	copper
Color	green
Impression	splendid

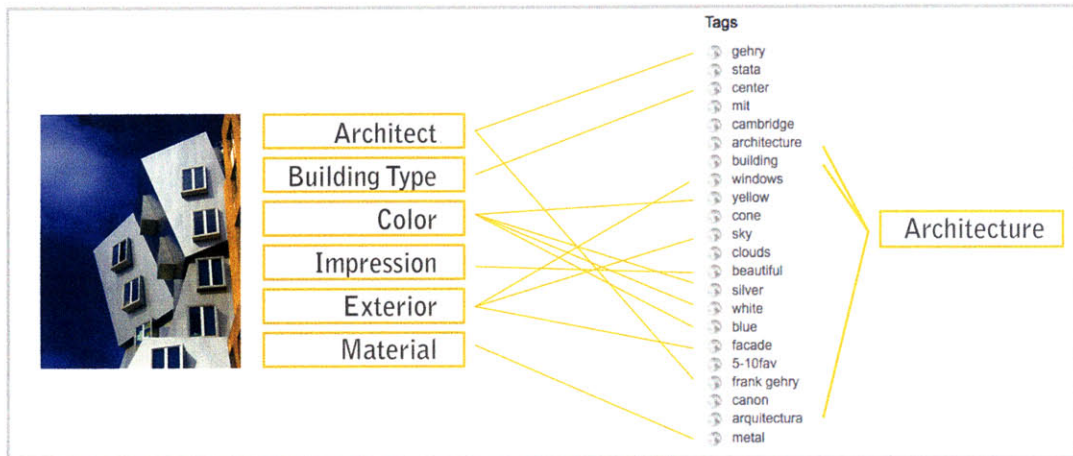


Figure 3-7
Mapping diagram illustrating how Trig'r extracts information from a set of tags that belongs to a Flickr photo related to MIT Stata Center

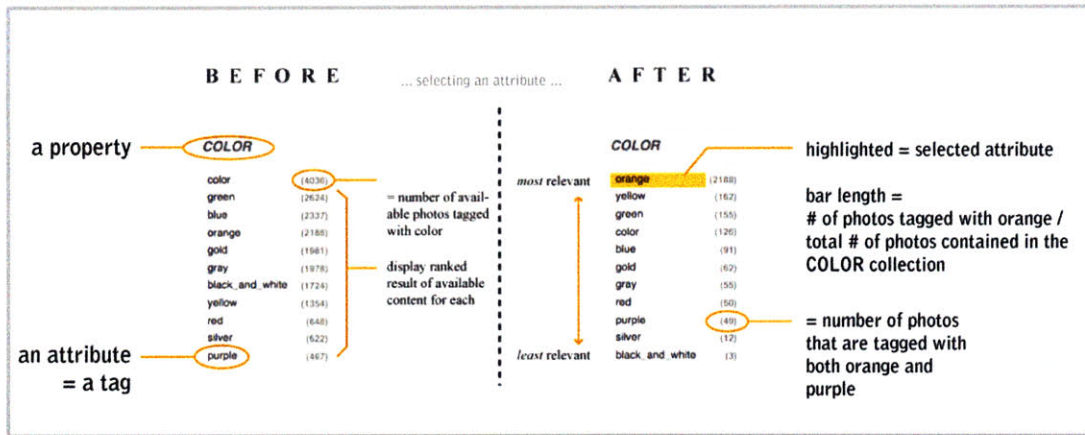
The sample Flickr database is built upon two conditions: (1) images that are posted and shared within the group of architecture. This is done for the purpose of acquiring qualitative architectural imagery. A group of people with focused shared interests in architecture/design are more likely to post architectural images with richer and better contents than those who are interested in football, (2) also with the additional condition that those photos must be tagged with either architecture or building as the most primitive filter to ensure the result of returning images.

Visual Browsing: Data Visualization Strategy

Facet Browser

Faceted search, also called *faceted navigation* or *faceted browsing*. Trig'r implements based on a Relation Browser which is a faceted browser that has made particular use of representing quantity (see Chapter 2). Each attribute represents a concept under its designated property. Users explore visual data by selecting particular attributes to acquire results that they prefer. The amount of content available in each attribute is labeled next to the attribute value. Bars are used to illustrate the percentage of available content of a particular attribute in relation to the total

amount of content in the collection that it belongs to. From looking at the portion of the colored bar behind each attribute, users easily obtain quick comparative feedback about the attribute they are about to select in terms of quantity and perhaps significance of preference on Flickr.



Sequence of Arrangement

Under each property, attributes are prioritized from top to bottom or left to right based on statistical significance in the total collection in the property. This way, users gain a ranked overview of the data set without any effort. It not only displays the ranked results of the photo count but also indicates the degree of relevance as users read the list of attributes in order. Both Explore and Matrix mode prioritize data as a means of organization and clarity of presenting search parameters.

Colors and typefaces

Hierarchy is clearly established with the use of color by keeping the background white while displaying the selected or selectable items in vibrant color and additional data information in light grey.

Drawing attention to items for interaction by using bright colors to highlight the attributes that are used to filter every search.

Figure 3-8
Each attribute represents a collection of photos that belongs to it and those photos may also belong to other attributes depending on the image's content. This figure gives an overview of the faceted-browser features implemented in Trig'r.

Color is used to indicate the active state of the selected item. Italic is used to identify the property that provides structure for the data's meaning. Moreover, the inactive items refer to those that are unselectable due to an insufficient number of photos. They remain in the background with a neutral and de-saturated color. This feature enables the users to stay aware of all their potential options.

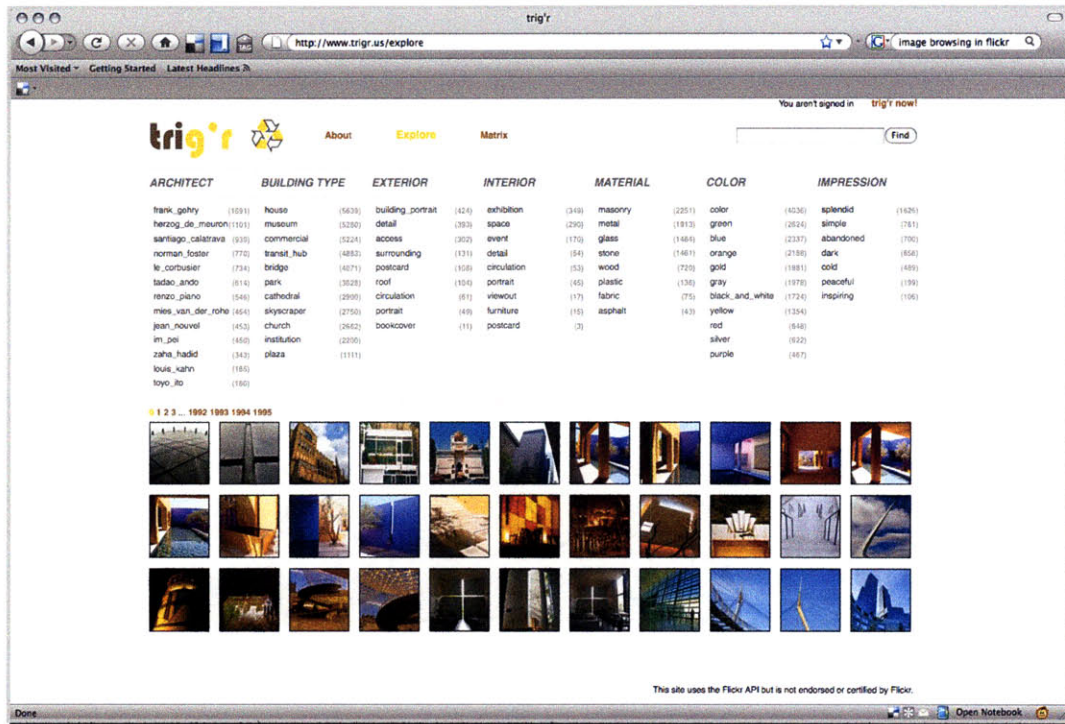
Interaction: Iteration

This is a particularly important stage of visualizing data, which allows the users to control their search query. Thus the users gain full perspectives on the data by refining or expanding their initial query. Trig'r enhances image browsing by allowing users to traverse back and forth between the results of different queries. The combination of selected attributes can be altered upon a user's preference. The search inquiry is not in chronological order; the set of filters can be modified in any sequence. In other words, the interaction aspect of the user interface is designed to promote exploration of architectural photographs in conjunction with the critical understanding of architectural design principles through iterating search queries.

Viewing Transition

With the implementation of the *Lightbox* applet, the navigation and transition through images is smooth and easy.

3.2. Trig'r | Explore Mode



As the title implies, this mode of Trig'r encourages users to explore visual data according to their own preferences. They have the option to delve into design research from any angle as they wish.

Unlike in a keyword search, the goal here is to allow users to easily gain full control of refining their search results. Perhaps with emergent findings and results, it would provoke curiosity in searching for more images to form perspectives on different design approaches. It is developed to yield an exploratory and experimental process for the users while they browse and research precedents and inspiration.

3.2.1. Implementation of Facet Browser

Faceted Browsing

Figure 3-9
Screen shot of the web page for Explore mode. The navigation is positioned at the top of the page along with user login field. Trig'r is meant to be a member-orientated web service. Members take the responsibility to contribute to the quality and usability of content. It is designed based on a demand-supply model.

As mentioned in Section 3.1.3., images are sorted according to their inherent tag set. Trig'r uses a set of pre-defined properties to parse images. With the implementation of a faceted browser, each image is not strictly defined by a concept but has the flexibility to fall into as many categories as its tag set entails.

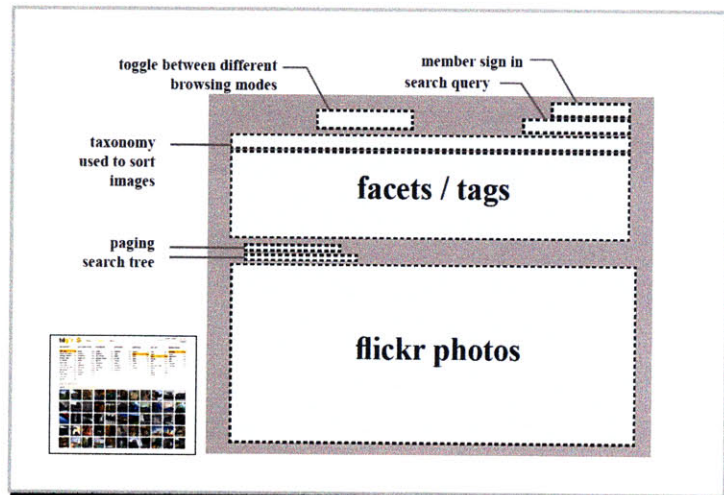
What users receive from this type of browser is the freedom of tweaking the search parameters/attributes in all properties. It displays the set of attributes that describes the characteristics of the property/concept. Take the property *material* for example. The concept of building materials can be understood with a subset of explanation such as masonry, metal, glass, stone, wood, plastic, fabric, and/or asphalt.

This act of adjusting and iterating different combinations of parameters ideally leads to a full comprehension of the results and definition of the parameters.

3.2.2. Interaction: User Interface Design

UI Layout Overview

Figure 3-10
The overall layout of the user interface. Components for image inquiry such as the search query field and facet browser are placed in the upper section of the page. Results are displayed in the lower section of the page along with search tree and pagination feature.



Unlike in a keyword search, the goal of this interface design is to allow users to easily gain full control of browsing through the use of Trig'r's taxonomy and refining search results according to the given structure. The layout is simple and straightforward: textual query on top, image results at bottom.

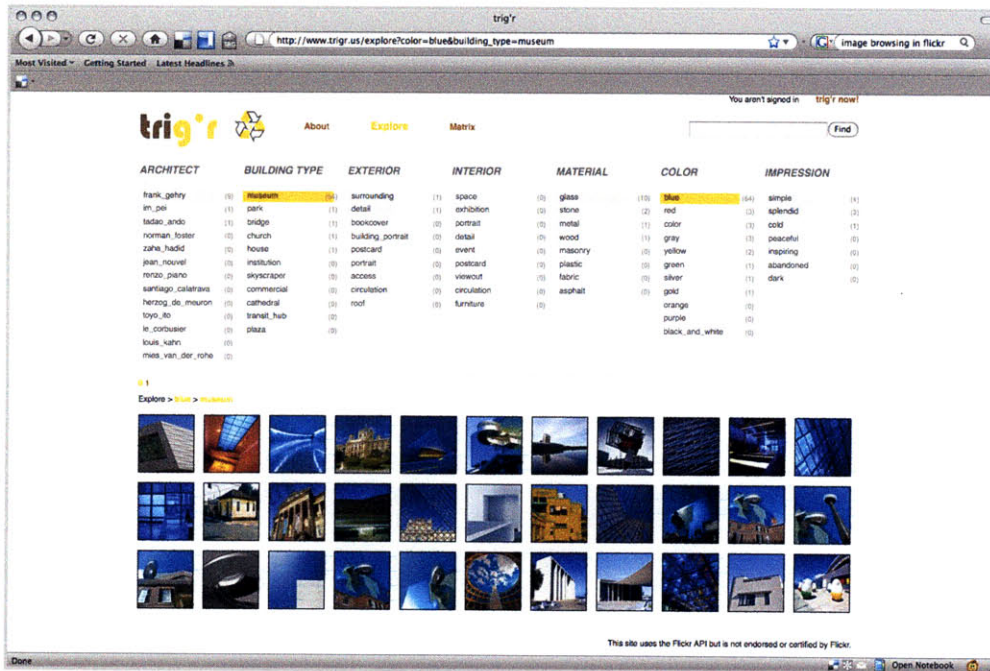
Details of Facet Browser

As described earlier, there are seven fixed categories and a fixed number of attributes for each category defined by the designer. The figures below illustrate the layout of the implemented facet browser in more detail.

Figure 3-11
Details of properties/facets



Guideline for Interaction



Explore

Figure 3-12
Details of facets
Figure 3-13
Screen shot of the web page for explore mode. The collection of thumbnails displayed at the bottom of the page presents partial result of the selected facets, museum and blue.

All columns of properties share the common underlying structure. One can start exploring by simply selecting attributes within a property and slowly moving across the columns. Alternating and combining tags from different columns gives the process of image browsing multidimensionality.

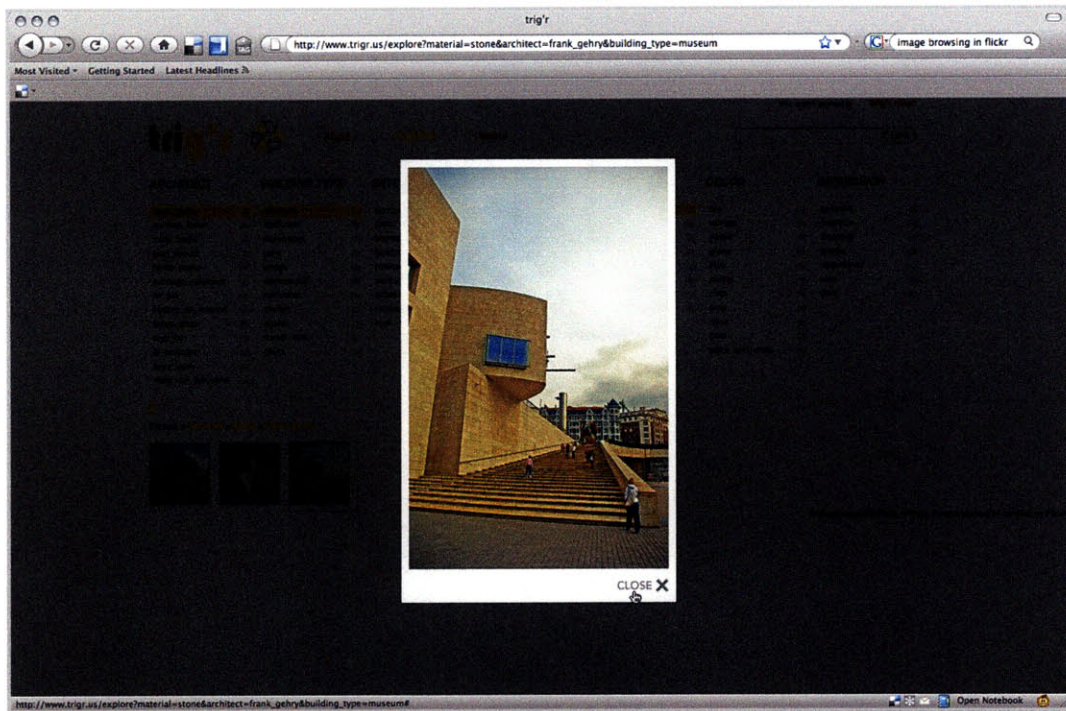
Interact Flexibility

Users can select any attribute they wish. There is no definite starting point to initiate a search. Any selected item can be de-selected by clicking on it again after it is activated. The attribute is highlighted as the user mouses over it.

Browse and Readability

A user has the option to view an image as a thumbnail or an enlarged version. The user enables the zoom feature by clicking on the thumbnail that he prefers to see in more detail. One benefit from viewing multiple thumbnails at once is the ability to visually discover hidden patterns of the particular image set or understand a search query in a glance. The pagination is used to browse images in the collection of thumbnails. It is possible to change attributes of the design such as the color of background from white to deep gray when the user decides to enlarge and focus on a particular piece of image.

Figure 3-14
Screen shot of the web page for explore mode with the enhancement of *Lightbox*. When user clicks on a thumbnail to enlarge a particular photo, this feature enables the user to examine images in detail.



3.3. Trig'r | Matrix Mode

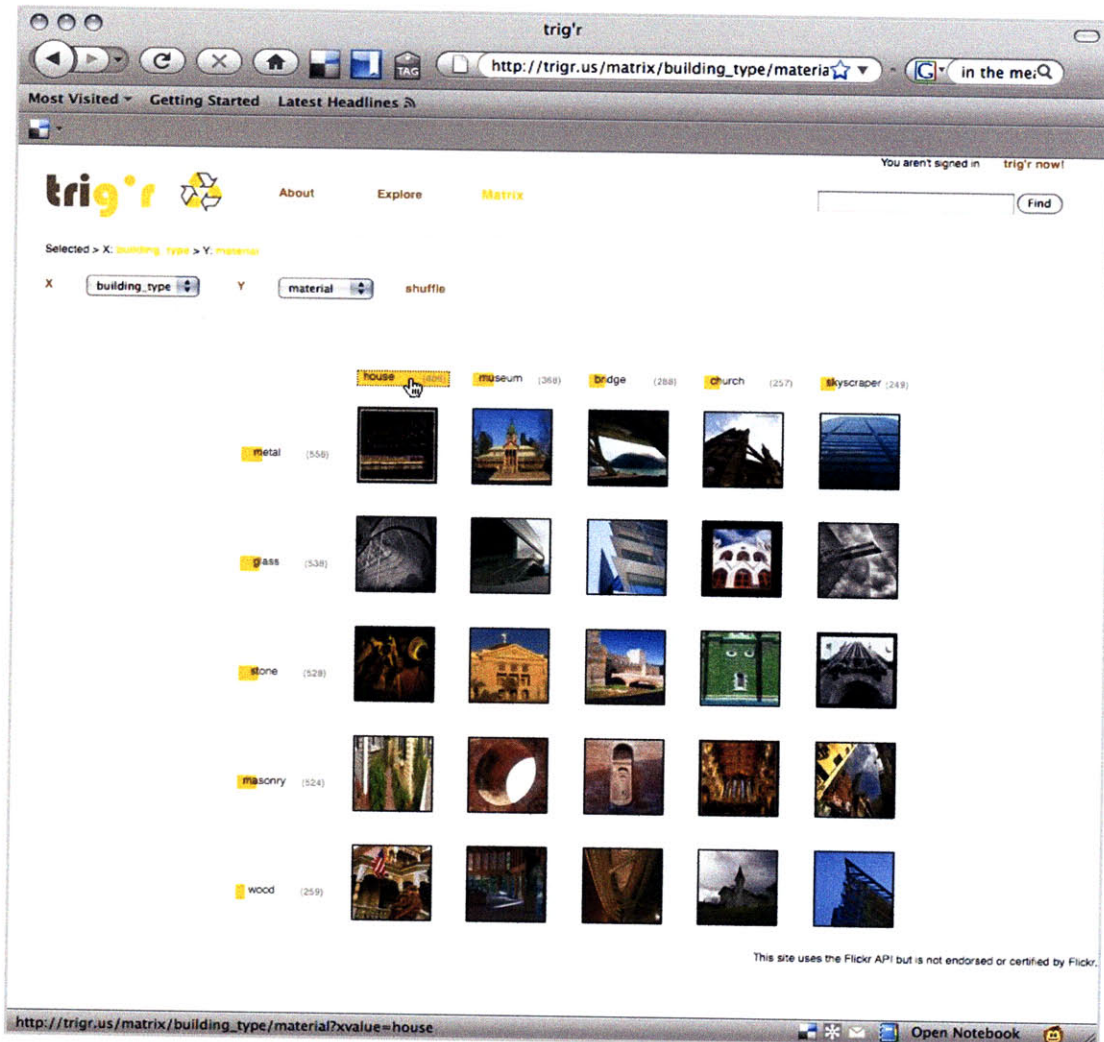


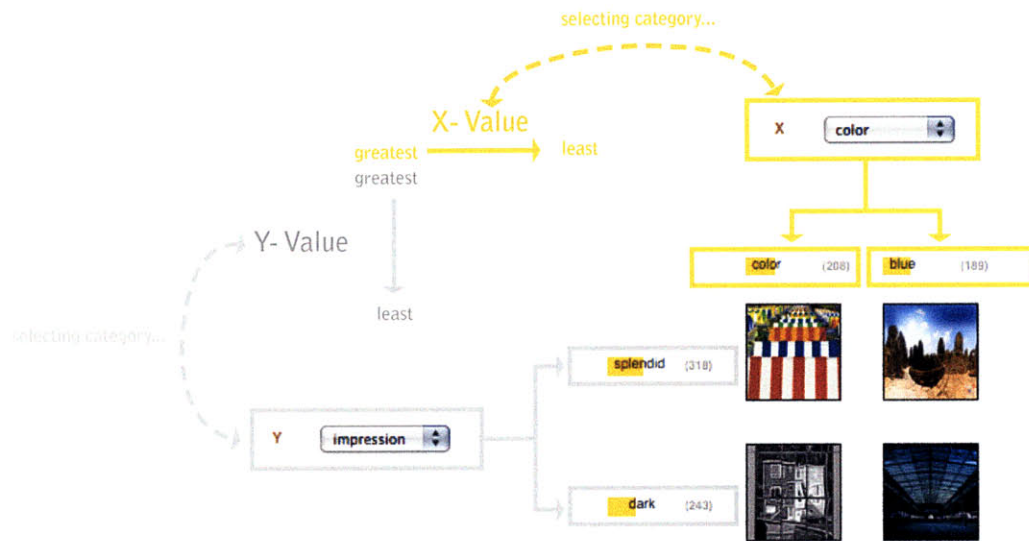
Figure 3-15
Screen shot of the web page for matrix mode. The design attributes of this UI stay consistent with Explore mode. Facet bar is arranged along both x and y axes to indicate the quantity and relevance.

Matrix is the advanced browsing mode of Trig'r. It is developed to display and explore images in a comparative way. It makes browsing images a reflective, efficient and critical process by visualizing images with a clear framework.

Unlike a typical image browsing or searching UI design, *Matrix* introduces a unique way to browse images non-linearly. Well-formed clustering of images is the key to this design. The act of acquiring images and viewing results of the query is not

structured in a streamlined fashion. Through interaction with and modification to Matrix attributes, the user begins to gain a full perceptive on the search query visually and statistically.

3.3.1. Implementation of Matrix Browser



The Matrix search interface consists of a matrix (browser) and few other elements for interaction. A matrix has two value axes, showing one set of facets along the x-axis and another along the y-axis. It combines these values into single data points and displays them in the appropriate cell in the matrix. The user has the option to custom set x and y values for the matrix. X- and y-value will each be one of the properties Trig'r classified, Architect, Building Type, Exterior, Interior, Material, Color, or Impression. For instance, if the user selects Architect as the x-value for the Matrix, then he/she will see the five top-ranked (determined by photo counts) attributes of Architect, such as norman_foster, frank_gehry, herzog_de_meuron, zaha_hadid, and ando_tadao displayed along across the x-axis of the matrix

Figure 3-16
Partial Matrix showing the relationship between x and y-value.

from left to right. Applying the same logic to the y-axis, he/she will expect to see metal, glass, masonry, stone, and wood displayed along the y-axis from top to bottom. Highest ranked attribute-set (it is a set because every cell is defined by a pair of x- and y- value) will always be displayed at the top left corner.

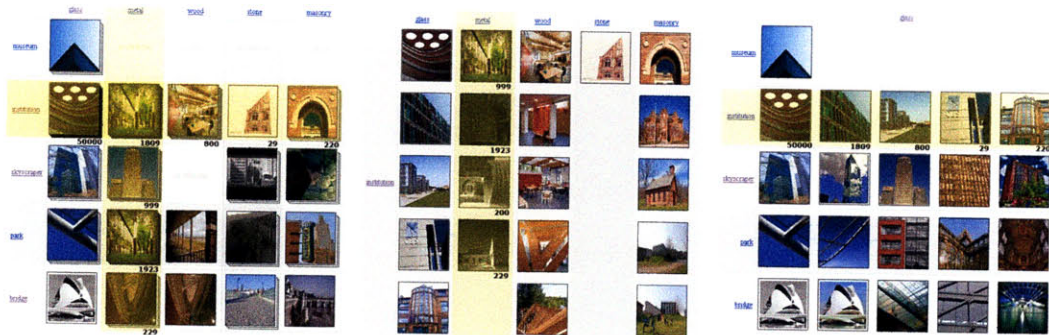


Figure 3-17
Early mockups illustrate the key features of the user interface design. It again gives user the flexibility to expand and refine search results visually through interaction.

For this version of Trig'r, the default setting size of the matrix is 5x5, offering the user the opportunity of viewing 25 images with unique characteristics at a time. Each unit of the matrix has a set of languages/definitions of its own. To browse the images, the user can either traverse across the column(s) horizontally along the x-axis or go down the column(s) along the y-axis depending on which variable he/she wants to constrain first. The Matrix way of browsing grants the user the chance to compare search results side by side vertically and horizontally without the mundane process of modifying the search query again and again, as in a typical keyword search scenario.

As previously mentioned, Matrix ranks images along both x and y directions, according to the size of the photo collection in each unit only. With that logic in mind, as one browses images diagonally from one corner of the matrix to another corner in the opposite end, the statistical association from one photo to another progressively decreases.

To avoid information overwhelm while browsing, the magnitude

of each unit sits in the background until the user engages with it.

There are two stages to the interactive browsing of Matrix. To ensure the clarity and readability of photographic representations presented in the matrix, color is only used to emphasize data priority. The user can interact with such a large amount of information passively or actively. Displaying thumbnails in matrix fashion provides the user with the scale of overall information instantly. The scalability of information is determined by the mode of user interaction with the data.

3.3.2. Interaction: User Interface Design

UI Layout Overview



Components required to set up the overall skeleton for the matrix are placed at the top left corner below the navigation bar. Images are present in the matrix. If there is no content available for a particular cell, it will appear as a blank cell. To fill in the missing data, the user can sign into Flickr through Trig'r, and upload images indexed with the set of similar taxonomy.

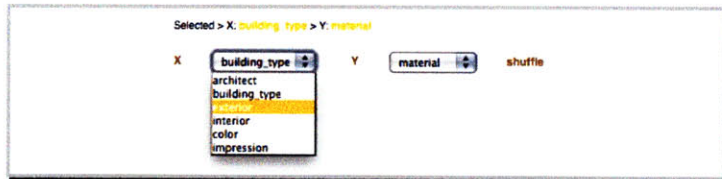
Figure 3-18
Screen shot of the web page for Matrix mode. Clustering of images is placed in the center of the page. Users have the choice of refining or expanding the number of facets along x and y-axis by clicking on the facet.

Interactive Features: Custom X & Y Dimension

As previously described, to adjust the property setting for the x and y dimensions of the matrix, the user custom sets x and y

values by scrolling down the pull-down menu to see the available properties for each axis, and selecting the most preferable item to acquire images. Images in the matrix then are synchronized with those selections.

Figure 3-19
Screen shot of the pull down menu for x and y dimension, search tree and Shuffle feature.



The string above the pull-down menu represents traces of the user's current locations within the search tree. It indicates the selected items for x and y. The *Shuffle* feature is also implemented to ease the browsing process. Every time the shuffle button is pressed, it refreshes and reloads all units of the matrix with another collection of images indexed similarly.

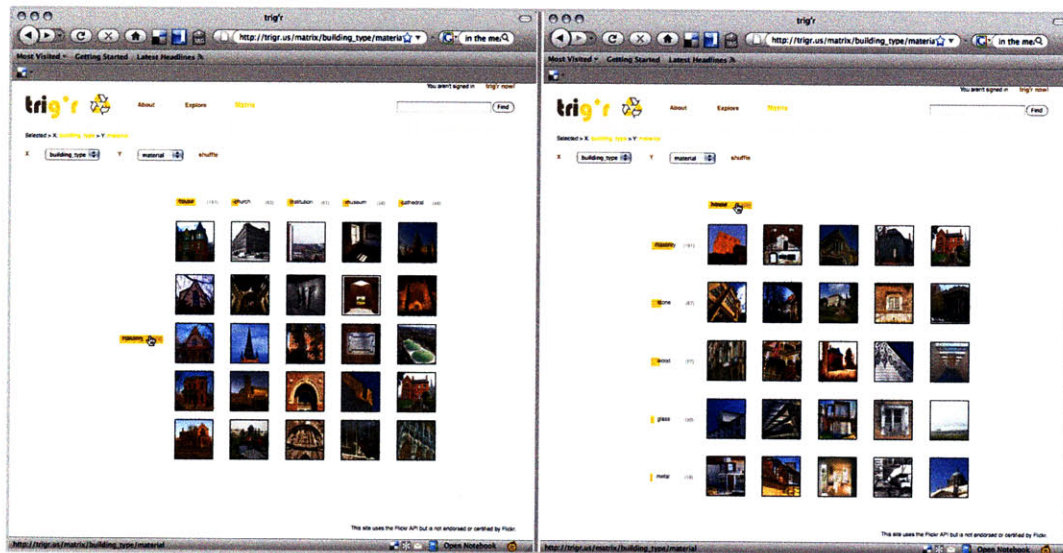


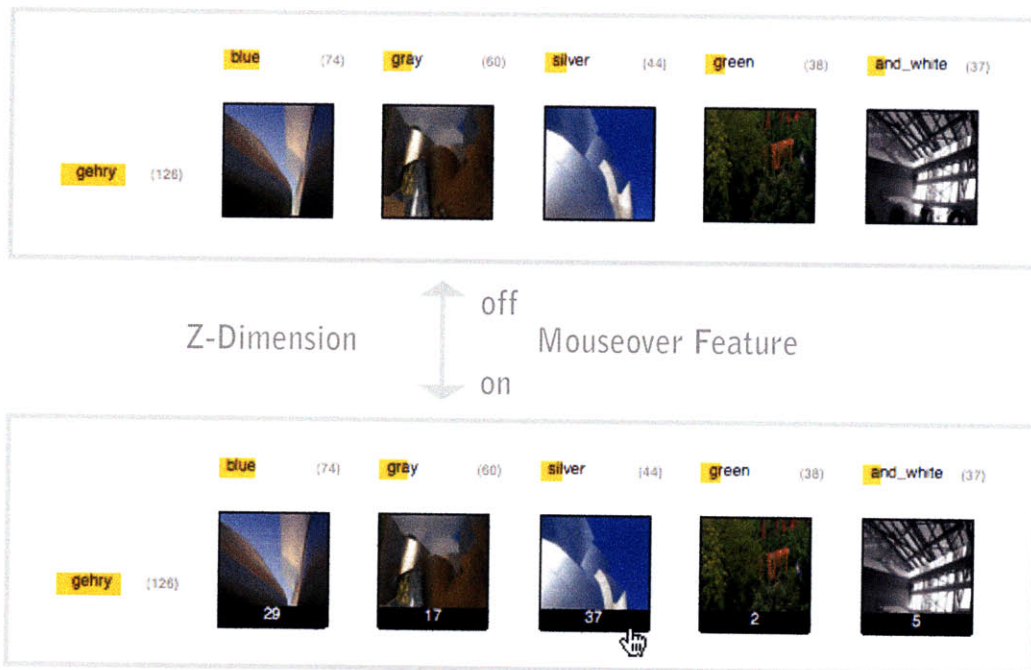
Figure 3-20
Screen shots of Matrix browser set to a dimension of 5 x 1. Users have the freedom to compare results in a row or column.

The uniqueness of this interface is that it not only displays an extensive set of structured data all at once but it also allows the user to intuitively and easily change the setting for browsing with a click of the mouse. The Matrix is displayed with a default

dimension of 5 units by 5 units. However, the display of content is not fixed to 5 by 5. The x- and y- dimensions for contents in the matrix are defined by the Trig'r user. In Figure 3-20, both screen shots illustrate a matrix with dimension 5x5 but contents with dimension 5x1 are arranged differently. If users want to look into how museums are designed differently for different types of construction material, and are trying to find out which buildings are most “interesting” and represent a good choice of material application, they will then set up the matrix by selecting *material* for x (or y) and *buildin_type* for the remaining field (or x, y in this case) in the pull-down menu for x and y. When all the images are loaded, they would click on the *museum* attribute that is listed on y-axis. This act will lead to a more concentrated and refined search, which achieves the goal of the task.

Figure 3-21
Screen shot of a portion of the matrix in closeup. It illustrates the z-dimension feature as a user mouses over that particular cell.

Informative Z Dimension



Mousing over any unit of the matrix activates the z-dimension feature. Numbers shown on top of each unit indicate the

available images in that particular unit. This feature is meant to portray the idea of a photo album/stock, imagining that each unit holds a stack of photos that are available for browsing. The number then represents the depth of the photo stack, the available pages in the album. In Figure 3-21, you would read the cell indexed with *gehry* and *silver* as follows: There are 126 pictures belonging to the *gehry* collection, 44 pictures belonging to the *silver* collection, and 37 pictures belonging to both *gehry* and *silver*.

Viewing Option

Enlarge, *Next* and *Close* are the last features to be introduced for the Matrix mode. Similar to the way *Explore* is implemented, the *Enlarge* feature is enabled when users click on a particular cell to obtain a closer look at the images in that particular collection. When they click on the thumbnail/cell they would like to focus on, an enlarged image appears in the center of the screen. The function sets the currently defined matrix in the background and shades it in dark gray.

Next is a mouse-over feature. It activates when users mouse over an enlarged image. It is positioned at the top right corner of the picture frame. As *Next* implies, users see the next image in the collection as they click on it.

The number of images available and the position of the current selected image in that collection will be indicated at the lower left corner of the image frame. The user has the option to *Close* the enlarged image and return to a previously defined matrix with the results in thumbnails.

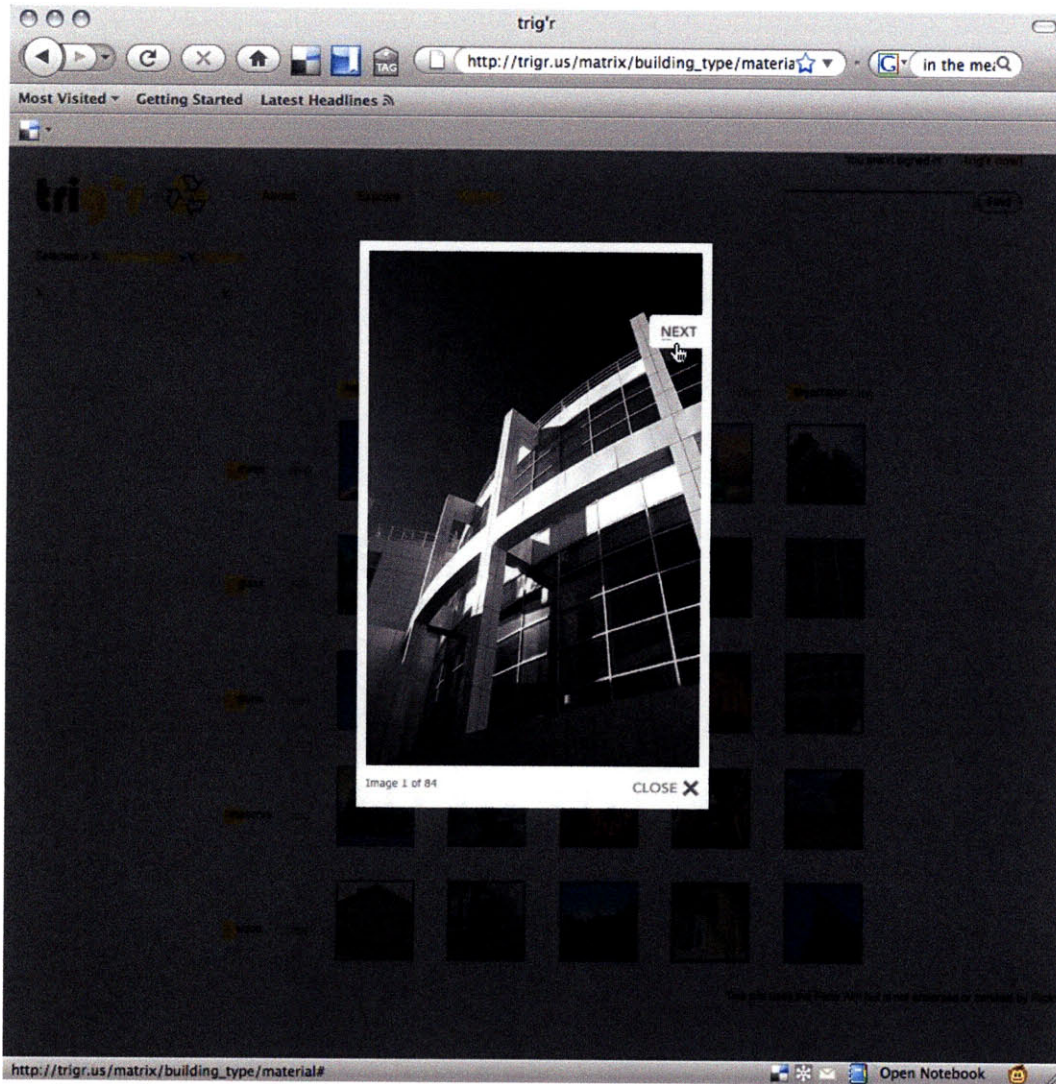


Figure 3-22
Screen shot of the image when user clicks on the thumbnail of it. Enlarged image allows the user to give it a much closer look or the subject.

CHAPTER FOUR

Analysis and Evaluation |

This chapter is divided into two sections. Each section takes a different approach to analyzing the design of the Explore and Matrix modes of Trig'r. The author of this thesis, as the designer of Trig'r, is also the test subject to evaluate the design of this application. The first section of the chapter demonstrates how to use Trig'r in a hypothetical scenario that best resembles the process of design research in real-life practice. The results retrieve from the query, then are listed and evaluated individually for each mode of Trig'r.

Before we discuss what Trig'r can offer as a web-hosted image search engine that makes effective use of a user-generated visual repository for the purpose of architectural design research, here is a brief overview of what the structure of this system is designed based on: (1) treating the design of a particular piece of architecture, Eifel Tower, for example, as a representation, (2) each representation consists of seven major properties: its creator, the *architect*, *building type* that it belongs to, design of the *exterior*, design of the *interior*, use of *material*, use of *color* and *impression* on its visitors or viewers. (3) Each property, *material* for example, is composed with several attributes, such as *metal*, *glass*, *stone*, *masonry*, *plastic*, *asphalt*, *steel*, (4) with which users can search for and retrieve photographs from the sample Flickr database by refining and expanding the subject's attributes for each property listed.

The faceted browser is implemented differently for the Explore and Matrix modes of Trig'r. The structure of the faceted browser is similar to that of a building design. As covered in Chapter Three, there are two modes of Trig'r: Explore and Matrix. Explore is most applicable in the first stage of design research: understanding the properties of architectural design as a single representation. Matrix ideally serves for the second stage of the research process: looking for precedents with similar and/or distinct properties and attributes.

In order to get a better understanding of the design for each browsing mode of Trig'r, we will first perform a research task with the aid of Explore, Matrix and a conventional browser in addition as a case study. This way, we can see if a particular type of browser is more applicable for a particular purpose than the other ones. Keep in mind that Trig'r is specifically designed for architectural design research. Since the beta version of Trig'r uses a sample database from Flickr, it makes sense to include the Flickr browser as a case study. Ideally, we will be able to notice the strength of the data visualization strategy designed for each of the three browsers under similar research premises.

A photograph is a literal representation of the architecture that is perceived. The goal of Trig'r is to serve as a tool for a user to effectively generate and construct understanding of architectural design through examining photographic representations posted and shared online.

Trig'r is intended to act as a motivational platform for architectural knowledge exploration through online-photography browsing with the enhancement of statistical information and flexibility in adjusting search parameters. The proposed data visualization platforms for Trig'r aim to provoke thoughts and reflection during image searching and browsing, and finally forming realizations within users. However, it is also to inform

the design process in a more efficient and effective way in support of design decision-making. The scenarios are designed to meet practical objectives as if the researching process was performed in a real-life situation.

4.1. How to Research and Design

Description of Hypothetical Scenario

Imagine yourself being appointed as part of a design team. You are asked to propose a few design iterations for the Museum of Art in Taipei, Taiwan. With no previous experience in museum design, you want to explore some images online to get a quick overview of the given task without going through the effort of studying planning and programming of the museum just yet. Let's say some acquaintance of yours recommends that you take a look at the Guggenheim Museum Bilbao by Frank Gehry and De Young, Fine Arts Museum of San Francisco by Herzog & de Meuron and few others.

Before you begin your search on those buildings, you should keep a few goals in mind while exploring the online visual repository, especially photos that are shared online among architects or groups of architecture hobbyists worldwide. Inquiries include:

- What is interesting about this building? What catches the photographic eye? Which attributes?
- What is the characteristic of each recommended building, based on the use of material and/or color? How are they different?
- How do people experience the building?

You can start researching with the three pieces of information

you are given: the name of architect, the name of building and the type of building. As you review the results, what does the number of photos tell you? What does the collection of pictures tell you? What are the possible conclusions you can draw with the aid of the Trig'r template for browsing photos?

4.1.1. Results from Flickr Browser



Objective Description:

Inquiry Procedure

1. Keyword search: Retrieve images that belong to the type of query the user chooses: *Photos, Groups, People, and Tags*.
2. Unsorted clustering of images.
3. Click on a display image to view in more detail, return to the previous page to continue browsing.
4. Explore/Tags mode is optional. The user has to choose to view images in detail in order to view the list of tags that the image is tagged with. If the user clicks on a tag in the shown list, tags mode is enabled. The user has the choice to browse images with the cluster of tags that he/she initially entered.
5. View/Sort by: This feature allows the user to sort images by most interesting, most recent or most relevant.

Figure 4-1
Screen shot of current Flickr browser. Users can easily toggle between different searching modes to retrieve content. Modes include: Photos, Groups, and People.

Statistical feedback

- Photos return: based on full text search
 - 29,994 results matching deyoung and museum
 - 56,205 results matching deyoung
- Groups return: based on Group names and descriptions
 - found 42 groups about deyoung and museum
- People return: based on full text search
 - couldn't find any results tagged with deyoung and museum
- Explore/Tags return: Refine the previously given deyoungmuseum list with cluster based on tags
 - 1200 photos
 - related tags: sanfrancisco, goldengatepark, california, museum, art, deyoung, sculpture, architecture, sf, glass

Level of Engagement

The user is expected to explore and discover all rollover features Flickr provides by means of mouse action. The flow of the image browsing process is interrupted every time the user changes his/her search query.

Subjective Interpretation:

Flickr is a service for people to share and post their pictures online. It offers raw data for anyone to use through its open API service. Flickr does not intend to structure the raw data by means of setting it into the right context. Users can form any type of groups they want and post images within the group whether or not the image is relevant to the title of the group. As a result, there are some groups with more focused postings while some are for private sharing. Flickr puts freedom in the hands of its user when he/she searches for images.

4.1.2. Results from Explore

The screenshot shows the trig'r website interface. On the left, a sidebar contains two main sections: 'ARCHITECT' and 'BUILDING TYPE'. Under 'ARCHITECT', 'herzog_de_meuron' is selected with a count of 101. Under 'BUILDING TYPE', 'museum' is selected with a count of 500. The main content area features a table with the following columns: ARCHITECT, BUILDING TYPE, EXTERIOR, INTERIOR, MATERIAL, COLOR, and IMPRESSION. The first row of data is highlighted in yellow, showing 'herzog_de_meuron' as the architect, 'museum' as the building type, 'detail' as the exterior, 'exhibition' as the interior, 'metal' as the material, 'red' as the color, and 'surreal' as the impression. Below the table, there is a pagination bar and a grid of 30 image thumbnails representing search results.

Objective Description:

Inquiry Procedure

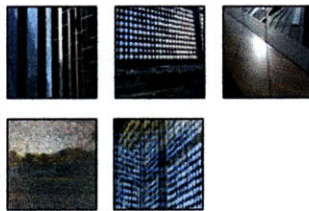
1. Keyword search: enter **De Young museum** into the query field.
2. Attributes **herzog_de_meuron** and **museum** appear selected under property **Architect** and **Building Type** respectively.
3. Related de young museum contents in the database are also indicated in the facet browser with available photo count listed in an orderly hierarchy from highest to lowest.
4. Return photos shown at the bottom of the page.
5. Click on thumbnail to enlarge images for a closer examination of details on subject or enable pagination for more content.
6. Refine search parameter by selecting attributes under different properties. Selecting attribute **detail** under **Exterior** for example will give another set of corresponded photos

Figure 4-2
Screen shot of return result for de young museum of Explore mode with an enlarged view of the ranked property list.

Explore > museum > herzog de meuron > portrait

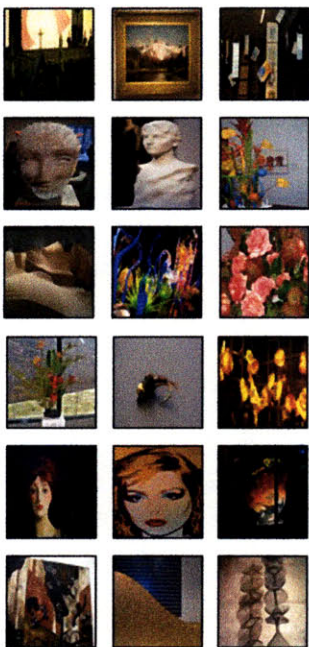


Explore > detail > museum > herzog de meuron



1 2 3 4 5 6 7

Explore > exhibition > museum > herzog de meuron



7. Deselect already selected item if you would like to explore other related attributes under the same property, or simply to expand the search.

8. Photos are sorted and updated based on the selected facets.

Statistical feedback

- Architect: herzog_de_meuron: *attribute selected* (See Figure 3-8,11 for description of different attribute modes)
 - 1101 results found
- Building Type: museum
 - attribute *unselected*: available options listed below
 - 590 results found for museum, 16 for institution, 15 for commercial, 4 for house, 2 for bridge
 - attribute *selected*:
 - 590 results found
 - 1 out of 590 results is related to bridge
- Exterior: attribute *unselected*: available options listed below, number of results is relative to the total collection of 590 images about herzog de meuron (and) museum
 - 33 results related to (exterior) building detail, 18 results for portrait (of photographer), 17 results for postcard-like photos, 4 results for building portraits, 2 results for building surrounding
- Interior: attribute *unselected*: available options listed below
 - 237 results related to exhibition, 165 for event, 40 for (interior) space, 31 for portrait, 17 for viewout (images capturing the view from inside of the building towards outside), 5 for (interior) detail
- Material: attribute *unselected*: available options listed below
 - 8 results related to metal

Level of Engagement

The process of retrieving images based on a set of architectural taxonomic terms is introduced as soon as the user begins his

Figure 4-3
Screen shot of return results for de young museum by browsing in Explore mode.

search. The user has full control to refine search results by selecting one of the available attribute options in any property, or deselect a previously selected item to expand search results. Sorted data is available to the user at any stage of the interaction.

Subjective Interpretation:

The user is able to get a quick overview of the building design through the use of the Explore browser by looking at overall attribute values in each category in a sorted order from highest to lowest content count. While researching for Flickr photographs related to Herzog & de Meuron and museum, the useful information and understandings that one gains from using Explore can be described in two ways:

Statistically

- Herzog & de Meuron are most known for their museums. They have done a few commercial projects and institutions, but they have not yet designed any mid/high-rise buildings or skyscrapers.
- Because they have a much larger set of images available for interior-related shots than exterior-related shots, their museums are not simply portrayed as iconic landmarks but perhaps the experience of the museum is pleasant, engaging and memorable.
- Exterior details of their design caught a lot of attention, but overall form doesn't appear to be to a prominent factor of their design.
- Museum exhibitions and events seem to be interesting and enjoyable. Users seem to appreciate interior space and the great opportunities for views from inside towards the outside.
- Metal is their most often used material for museums.
- Color doesn't seem to be a signature attribute to their

designs.

- The design or feature of the building doesn't seem to leave an impression that is noticeable enough to be mentioned.

Photographically

- Eye-catching exterior details for the De Young museum include: (a) geometry of shifted/twisted tower, (b) perforated copper cladding, (c) overhang form-factor, and (d) roofing design.
- Portraits are mostly taken with the artifact in the outdoor sculpture garden or with the twisted (observatory) tower in the background. The twisted tower becomes the photographic iconic feature to identify De Young museum.
- There is a huge success for the museum curators. People tend to photograph exhibition artifacts in detail to share online. The museum design also seems a very welcoming and inviting venue for public activities. It provides a lively environment and well-equipped facilities for hosting events, such as concerts, art openings, book signings, etc. Interior space seems to work well with artifacts in all dimensions and characteristics.
- Viewout shots are quite uniformly represented. They are mostly taken from the conservatory on top of the twisted tower and look over towards another museum across the park. Those images provide a reference to what people find interesting when panning around the cityscape from a high point.
- Some of the interior-detail images are actually images that attempt to capture exterior details of the perforated metal cladding from inside through glazing. The shattered-like glazing that is deployed as one of the interior feature draws some close-up attention.
- Their Prada "diamond" Tower in Tokyo is the most well received commercial building.

Summary

Enhanced by faceted classification for user-generated and architectural-specific tags, photographic representations of the building are sorted meaningfully and in an orderly way. Explore makes the access to a huge collection of Flickr information much quicker for the user by filtering the available information. The assignment of multiple meanings to a photograph enables the user to explore the subject in multiple taxonomic ways. Moreover, the available information in this scenario reflects collective interest in a particular subject even though at this stage of the prototype, it does not reveal semantic values.

Treating a building as an entity defined with a set of tags, and extracting attributes from pre-existing fields in the database seems to reveal the primarily characteristics of the design sufficiently by the means of crowd sourcing with the assistance of the general public.

4.1.3. Results from Matrix

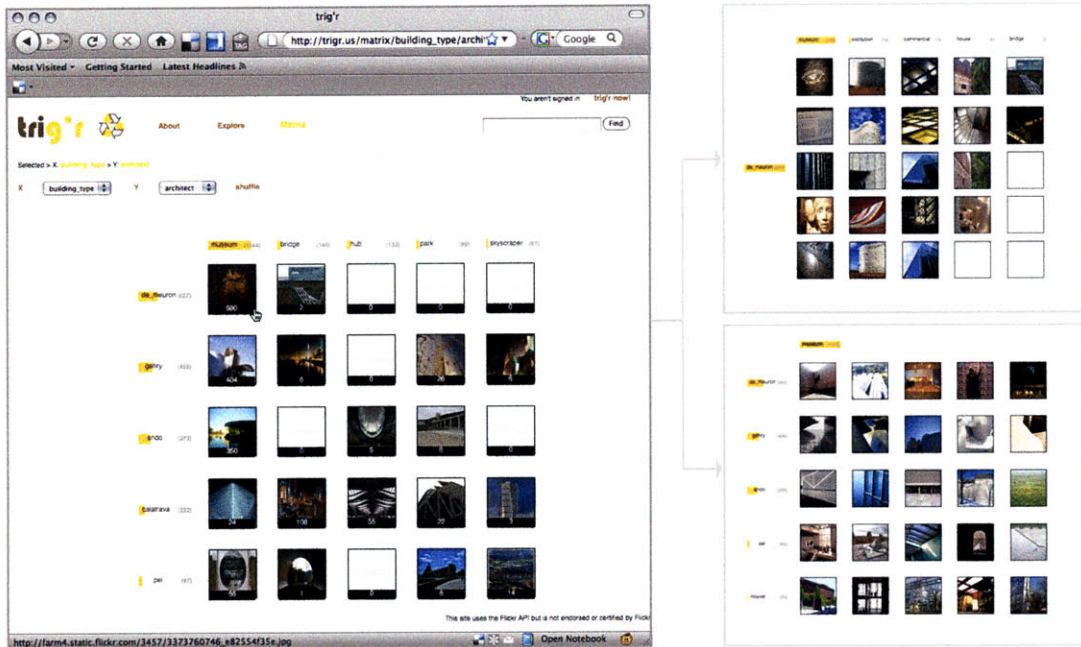


Figure 4-4
Screen shot of return results for de young museum by browsing in Matrix mode.

The Matrix browser aims to serve as an advanced search feature for the Explore mode once the user has a better understanding of the query subject from Explore browsing. In regard to the beta version of Trig'r, keyword search is not applicable. We will skip entering a keyword into the query field, and begin the search by exploring a subject with given properties or attributes. In addition, only the top 5 most populated attributes are displayed for each category.

Objective Description:

Inquiry Procedure

1. Select building type and architect for x and y values
2. Review values for each unit of the matrix
3. Select museum as the focused attribute for x or select Herzog & de Meuron as the focused attribute for y

4. Examine results
5. Adjust search parameter: select material as new value for x
6. Examine results

Statistical feedback

- Default matrix dimension 5 attributes x 5 attributes, where x = building type, y = architect. Matching images to the listed facet attributes of each classification are shown in the appropriate unit of the matrix.
 - Building Type: attribute *unselected*: available options
 - 1544 images found for museum, 140 for bridge, 132 for public transit hub, 89 for park and 67 for skyscraper
 - Architect : attribute *unselected*: available options
 - 627 images found for Herzog de Meuron, 455 for Frank Gehry, 373 for Tadao Ando, 222 for Santiago Calatrava, 97 for I.M. Pei
 - Table 1: listing results found for each cell in matrix

Table 1
Listing numerical results shown in matrix based on the search for building type and architect.

	Museum 1544	Bridge 140	T.Hub 132	Park 89	Skyscraper 67
Herzog 627	590	2	-	-	-
Gehry 455	404	6	-	26	6
Ando 373	350	-	5	6	-
Calatrava 222	24	108	55	22	3
Pei 97	65	1	-	8	14

- Adjust parameters for further exploration by replacing building type with material
 - Building Type: attribute *unselected*
 - Material: attribute *unselected*
 - Available contents are listed in Table 2 below

	Metal 104	Glass 89	Wood 16	Stone 11	Masonry 5
Gehry 64	26	16	15	5	1
Calatrava 49	29	20	-	-	-
Hezog 34	19	15	-	-	-
Foster 22	5	14	-	-	1
Pei 16	3	10	-	2	1

Table 2
Listing numerical results shown in matrix based on the search for building type and architect.

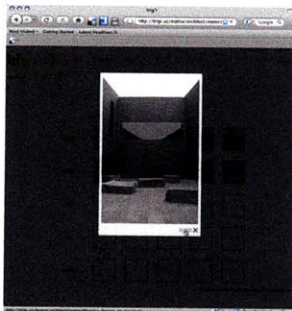
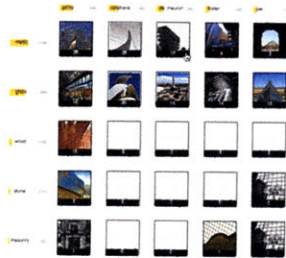


Figure 4-5
Screen shot of return results of matrix search based on architect and material.

Level of Engagement

With the benefits of prioritizing information and presenting it visually, Matrix permits its users the quick interpretation of the information they are looking at. The Matrix way of displaying information is a quick overview of all subjects with common attributes in a glance. Interaction with the interface could be either passive or active depending on the user's desire to acquire photographic knowledge on relevant subjects. He/she has the flexibility to actively alternate the number of focused attributes displayed along each x- and y-axis by clicks of mouse. The z-axis feature sits in the background unless the user initiates it.

Subjective Interpretation:

Statistically

- Herzog & de Meuron are most recognized for their museum design and don't seem well rounded in terms of involvement with other types of projects.
- Frank Gehry is well received for his museum design and also his accomplishment in park planning.
- Tadao Ando does not deal with structures like bridges.
- In terms of expertise and specialty in design, Herzog & de Meuron, Frank Gehry and Tadao Ando have drawn a lot of public interest and appreciation for their museum design, while Santiago Calatrava has outstanding recognition for his

excellence in bridge, transit hub station and park design, and I.M. Pei for his skyscrapers.

- Santiago Calatrava ranks the highest not for the total photo count but definitely for his capability in designing interesting architecture for all types of architecture. He is the only one on the list who is successful across the spectrum of public-orientated architecture design.
- However, when it comes to novelty in material application, Frank Gehry is undoubtedly the biggest winner. He is extremely well recognized for his work with metal.
- For every architect that is listed, metal and glass seem to contribute to the main characteristics of contemporary architecture. Construction materials such as wood, stone and masonry seem to have gradually lost the appreciation of architects and photographers with time.

Photographically

- What Gehry offers to the public is an iconic piece of architecture. It is uncommon to find images of his building repeating itself with respect to how it is photographed. Photographers are constantly exploring all possible vantage points and perspectives to photograph his buildings.
- Other factors that also make Gehry the most photographed architect are: (a) his innovative choice of material application on dynamic geometric forms, (b) the complexity of his expressive building form giving rise to good photographic composition, (c) the reflective and futuristic characteristics of sheet metal, which make it a perfect subject for photographic exploration with the enhancement of light at different times of day.
- His buildings are rightfully considered interesting and photographic-eye-catching for all their design form factors. A lot of close-up shots are posted, which give architectural experts a good opportunity to examine his detailing



Figure 4-6
Screen shot of return results of matrix search based on gehry and material, herzog and material, calatrava and material.

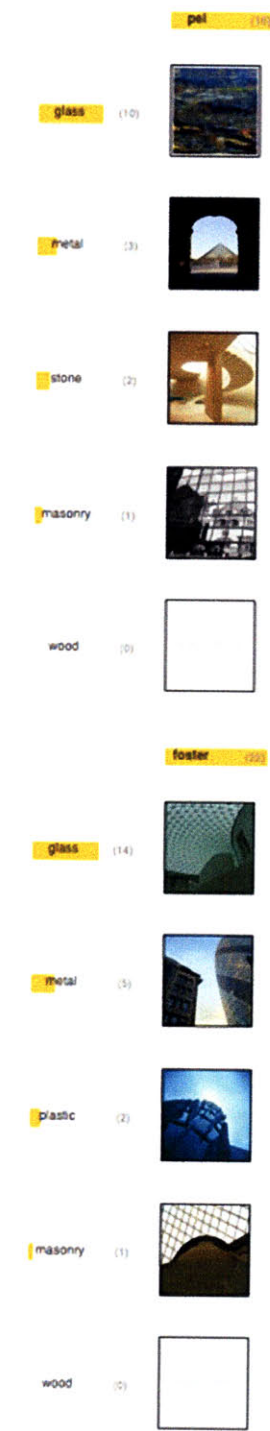


Figure 4-7
 Screen shot of partial return
 results of matrix search based
 on pei vs material and foster vs
 material.

deficiency. Also, they serve as great precedents for people who are interested in learning different treatments and designs for materials such as metal, glass, masonry, stone, etc.

- Herzog & de Meuron’s designs, on the other hand, are very much interior and functionality driven. They offer quality in experience both architecturally and content-wise. They are considered moderately expressive in quest of designing overall building form. Nevertheless, they seem to have quite an audience appreciating their spatial design. Spectacular views are offered and arranged meticulously throughout their design. Their museums seem to be well facilitated for all kinds of exciting events.
- Although Herzog & de Meuron are well known for their unique design approaches and innovative use of material for building exteriors, due to the simple and uniformly articulated treatment to the façade design of De Young Museum, it did not catch as much attention as an architect would have expected to see in the search results. It is definitely worth noting and is photographed in an architectural design sense but the uniformed color of the copper cladding made the enormous scale of the museum a perfect background for photographic composition. Artifacts are very pronounced in the foreground when they are photographed against the building skin in the background.
- Ando is very reserved with building form. His buildings typically are geometrical and uniformly repetitive. A photo collection of his buildings leaves a uniform impression on the viewer. They are simple, elegant and inspiring. Neat construction details of concrete and glass are well received and captured in photos.
- Calatrava is well appreciated for his structural elements. They are dramatically pronounced and articulated. A dynamic spatial experience that is perceptually engaging is a

result of light and skeleton-like structures, which permit natural light for illumination while casting dramatic shadows and reflections on the building surface.

- Pei and Foster are very similar in their tastes for materials. Structurally articulated skylights and geometrically expressive space frames are their most popular features.

Summary

Users are loaded with an extensive amount of information as they search. This is the second stage to Trig'r. Users benefit the most from first understanding the scope of the initial inquiry through Explore and broadening the scope by taking a step back and looking carefully at the data with perspectives informed previously.

4.2. What Is the Effect of Architecture?

Stereotypical results?

This section analyzes and evaluates the potential of Flickr data in conjunction with the design of Trig'r. This beta version is implemented with a Flickr sample database of 65,000 images and sorted according to the classifications Trig'r defines. The proposed system frameworks are evaluated based on how informative the user-generated contents are, both visually and verbally. Can designers gain insights into how architectural design affects people on an emotional level? By examining results from Trig'r, can we define attributes that contribute to collective design aesthetics?

Furthermore, can we point out what makes the brand of an architect from Trig'r results? What is the collective perception of architecture formulated based on web-posted imagery? By posing these questions, this chapter is structured to deliver responses from Trig'r results.

4.2.1. Results from Explore

Figure 4-8
Steps to retrieve and refine images from Explore mode.

It Feels Simple

Step 1 - Simple

ARCHITECT	BUILDING TYPE	EXTERIOR	INTERIOR	MATERIAL	COLOR	IMPRESSION
tadao_ando (11)	museum (26)	detail (2)	circulation (2)	metal (2)	gray (9)	simple (37)
santiago_calatrava (4)	house (23)	access (2)	detail (2)	glass (1)	color (6)	inspiring (32)
mies_van_der_roye (4)	commercial (16)	surrounding (0)	space (0)	masonry (0)	blue (5)	splendid (21)

Explore > simple

This site uses the Flickr API but is not endorsed or certified by

Step 2 - Simple - Museum

ARCHITECT	BUILDING TYPE	EXTERIOR	INTERIOR	MATERIAL	COLOR	IMPRESSION
tadao_ando (5)	museum (26)	detail (1)	space (0)	glass (0)	gray (0)	simple (26)

0 1 2 3 ... 9 10 11 ... 20 21 22 23

Explore > simple > museum

Step 3 - Simple - Tadao Ando

ARCHITECT	BUILDING TYPE	EXTERIOR	INTERIOR	MATERIAL	COLOR	IMPRESSION
tadao_ando (11)	museum (5)	surrounding (0)	space (0)	glass (0)	gray (0)	simple (11)

Explore > simple > tadao_ando

Objective Description:

Inquiry Procedure

1. Select attribute **simple** under property **impression**
2. Review results returned under every property
3. Repeat select and browse possible choices

Statistical feedback

- Impression: **simple** attribute *selected*
 - 761 images found
 - most associated attribute under impression: **inspiring**
 - Top three results returned from all properties, based on impression: **simple**

Architect	Building Type	Exterior	Interior	Material	Color
Ando 44%	Museum 26%	Detail 50%	Circulation 67%	Metal 35%	Gray 24%
Calatrava 16%	House 23%	Access 50%	Detail 33%	Glass 23%	Color 21%
_Rohe 16%	Commercial 16%	-	-	Masonry 19%	Blue 14%

- Top results returned from all available properties, based on impression: **simple** and building type: **museum**

Table 3
Results from search based on
simple
Table 4
Results from search based on

Architect	Exterior	Color
Ando 100%	Detail 100%	Gray 46%

Subjective Interpretation:

Statistically

Japanese architect Tadao Ando seems to be well recognized for his simple approach to architectural design. Exterior details of his buildings seem to be outstanding. Tadao Ando symbolizes simplicity.

Photographically

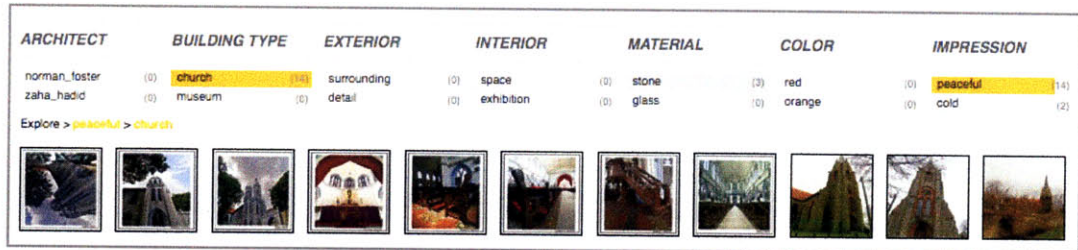
- By looking closely at the results found for impression: simple buildings captured in those images all share very similar characteristics: (a) simple use of color (b) simple geometry/form (c) simple and uniform design language, (d) modern or contemporary style (e) repetitive and identical design patterns and typologies, (d) systematic and organized layout for design elements, and (e) simple combinations of choices of material.
- All images belonging to **Tadao Ando** and **simple** are black and white. It seems that the use of color is unnecessary here to capture the quality of his design. From examining those images in more detail, elements of his characteristic style are apparent to the eye, for example, his preference for concrete and water, meticulous exterior concrete detailing, strategic framing of views, and staging architecture for the play of light. They all seem to be well encapsulated and vividly demonstrated. The great use of light in his buildings is well illustrated through those photographs.

It Feels Peaceful

Step 1 - Peaceful



Step 2 - Peaceful - Church



Objective Description:

Inquiry Procedure

1. Select attribute **peaceful** under property **impression**
2. Review results returned under every property
3. Repeat select and browse possible choices

Statistical feedback

- Impression: **peaceful** attribute *selected*
 - 199 images found
 - most associated attribute under impression: **splendid**
 - Top two results return from all properties, search based on impression: **peaceful**

Figure 4-9
Steps to retrieve and refine
images from Explore mode.

Architect	Building Type	Exterior	Interior	Material	Color
Ando 50%	Church 27%	Roof 100%	-	Stone 43%	Gray 22%
Kahn 50%	House 25%	-	-	Masonry 29%	Orange 19%

- Material: **stone** was the only result returned from all properties, based on impression: **peaceful** and building type: **church**

Table 5
Results from search based on peaceful

Subjective Interpretation:

Statistically

Interior design is the only property that does not reflect any association with the effect of peace. Buildings constructed with the use of natural materials and elements may be more likely to offer people the feeling of peace. Attributes listed under color also reinforce this argument, gray for stone and orange for brown-red bricks. Tadao Ando's and Louis Kahn's works particularly comforts their viewers with a sense of calmness and serenity.

Photographically

- Peaceful is a term referring to situations, scenes, and activities free of disturbance, strife or agitation. Disregarding their building type, those buildings that are photographed seem to have a common factor, being situated in a natural context with a serene landscape instead of an urban environment. There is usually a connection to the natural elements. The serene landscapes of their surroundings in conjunction with the natural elements of the buildings perhaps suggest a sense of mellowness and composure.
- The red-brown brick, articulated stone trim, and brick-and-stone striping are colors and material details that are illustrated in photos.

It Feels Cold

Step 1 - Cold

ARCHITECT	BUILDING TYPE	EXTERIOR	INTERIOR	MATERIAL	COLOR	IMPRESSION
norman_foster (1)	house (26)	building_portrait (5)	space (3)	masonry (0)	blue (9)	cold (489)
santiago_calatrava (1)	bridge (18)	detail (3)	exhibition (0)	glass (7)	gray (12)	dark (13)

Explore > **cold**

Step 2 - Cold - Bridge

ARCHITECT	BUILDING TYPE	EXTERIOR	INTERIOR	MATERIAL	COLOR	IMPRESSION
norman_foster (0)	bridge (8)	surrounding (1)	space (1)	masonry (1)	gray (3)	cold (18)
zaha_hadid (0)	museum (1)	building_portrait (1)	exhibition (0)	glass (0)	red (0)	splendid (0)

Explore > **cold** > **bridge**

Objective Description:

Inquiry Procedure

Figure 4-10
Steps to retrieve and refine
images from Explore mode.

1. Select attribute **cold** under property **impression**
2. Review results returned under every property
3. Repeat select and browse possible choices

Statistical feedback

- Impression: **cold** attribute *selected*
 - 489 images found

- most associated attribute under impression: **dark**
- top two results returned from all properties, based on impression: **cold**

Table 6
Results from search based on impression: cold

Architect	Building Type	Exterior	Interior	Material	Color
Foster 33%	House 20%	Blg_portrait 42%	-	Masonry 35%	Blue 24%
Calatrava 33%	Bridge 13%	Detail 25%	-	Glass 23%	Gray 21%

- Only the top two results returned from all available properties are listed, search based on impression: **cold** and building type: **bridge**

Table 7
Results from search based on impression cold, and building type: bridge

Exterior	Material	Color
Surrounding 50%	Stone 100%	Gray 50%
Blg_portrait 50%	-	Red 25%

Subjective Interpretation:

Statistically

Photographs that are focused on capturing building exterior detail or overall look seem to be the type of photographs that are more descriptive and demonstrative than inspiring.

Photographically

What makes an architectural photograph cold? It is clear in this series of pictures that the physical state of being cold and the remote and isolated characteristics of the context determine the use of this particular expression. Most photographs were taken in the midst of winter, and the presence of snow covering the ground plan and rooftops illustrate the coldness even more strongly. A few common illustrations are: (1) houses in isolation with no sign of humanity in surrounding area, such as abandoned empty lots, empty streets. (2) a vacant balcony with nobody occupying it, empty streets, and (3) houses without illumination shooting from inside out.

Review

Simple

This expression is very directly related to the way buildings are designed. Simple can be a response visually or emotionally. The simple and soothing experience seems to be a subsequent effect. It is a state of mind. It is self-apparent that to illustrate the idea as a simple flow of events or as an experience or as a formal architectural design approach, the most critical aspect is not the application of color, but the underlying frameworks which systematically organize events and design components.

Peaceful

This expression is mainly reflected and evoked by the context in which the photographer is situated or to which the photographed subject belongs. A well-kept church will most likely give users a sense of peacefulness. It is the association and familiarity with the church that dominates how it is perceived. Viewers can project themselves being in the scenes in the photograph and feel the experience vividly in their head. It is spiritual. Understanding the properties and functions of the space constitute the experience of peacefulness.

Cold

This expression is very much related to the physical state of the representation. Photos taken in winter will most likely be labeled with this expression to indicate the state of physicality. Blue and gray are dominating colors in most of the pictures from this collection. They tint the atmosphere of the subject with sadness, coldness, and solitude. Another physical attribute of photographed subject that triggers the viewer to use this expression is when a building and its surroundings appear to be in a state of separation, seclusion, isolation, and lack of the presence of humanity. To recreate the experience of cold, those are the principles the designer can apply.

4.2.2. Results from Matrix

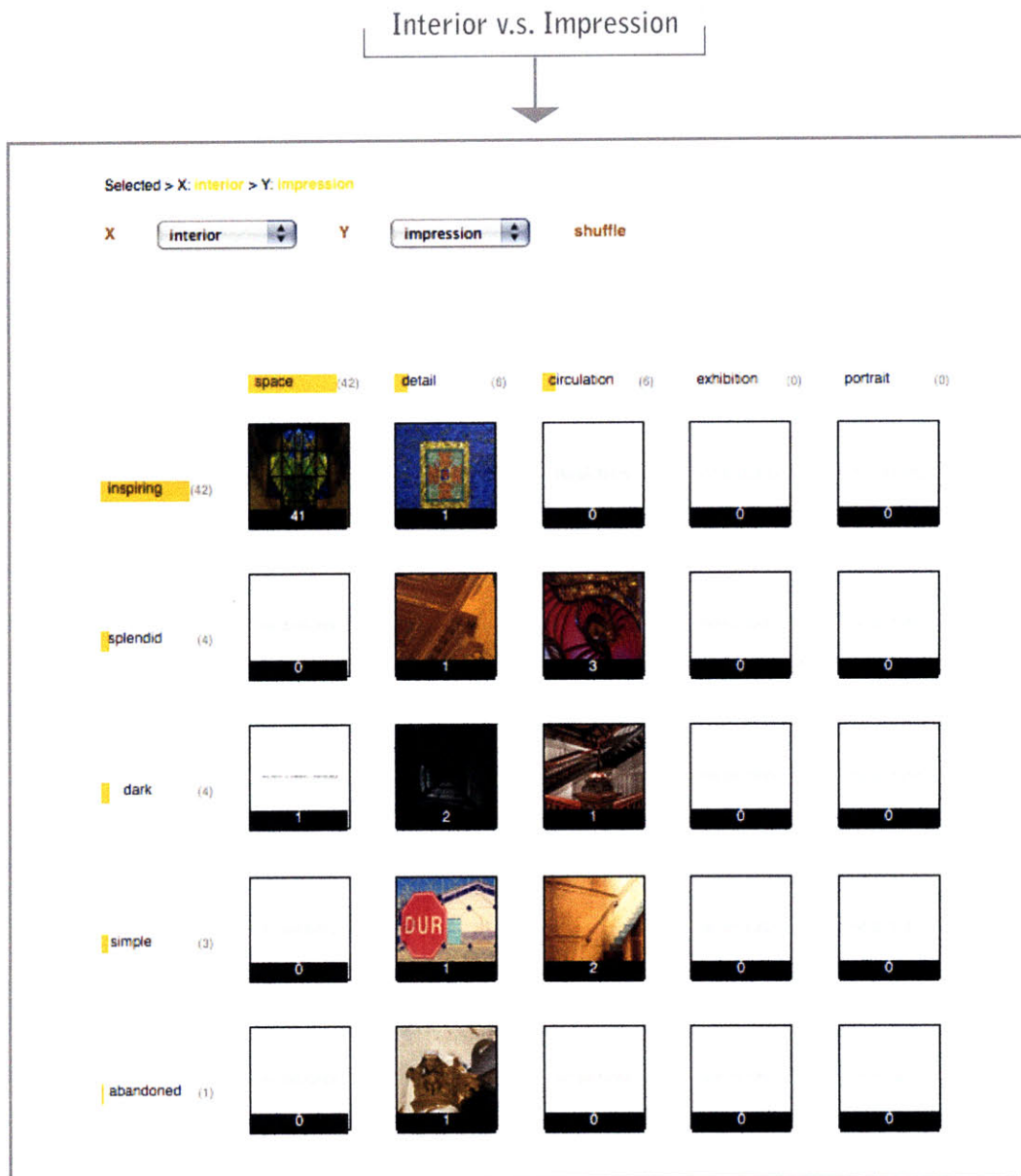
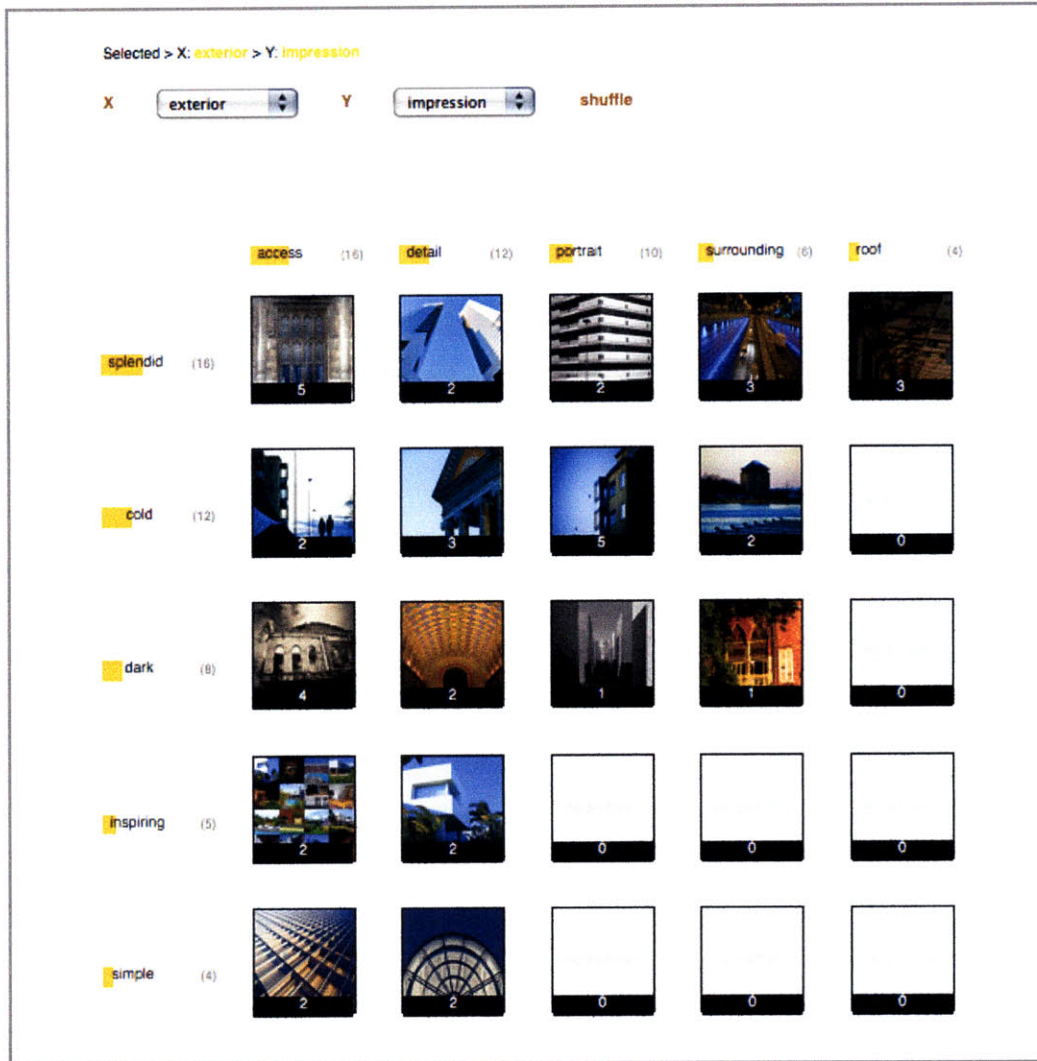


Figure 4-11
Steps to retrieve and refine
images from Explore mode.

Exterior v.s. Impression



Objective Description:

Statistical feedback

- Default matrix dimension 5 attributes x 5 attributes, where x = **exterior**, y = **impression**. Matching images to the listed attributes of each property are

Figure 4-12
Steps to retrieve and refine
images from Explore mode.

shown in the appropriate unit of the matrix

	Access 16	Detail 12	Portrait 10	Surrounding 6	Roof 4
Splendid 16	41	2	2	3	3
Cold 12	2	3	5	2	-
Dark 8	4	2	1	1	-
Inspiring 5	2	2	-	-	-
Simple 4	2	2	-	-	-

- Default matrix dimension 5 attributes x 5 attributes, where x = **interior**, y = **impression**. Matching images to the listed attributes of each property are shown in the appropriate unit of the matrix

	Space 42	Detail 6	Circulation 6	-	-
Inspiring 42	41	1	3	-	-
Splended 4	-	1	1	-	-
Dark 4	-	2	2	-	-
Simple 2	1	1	-	-	-
Abandoned 1	-	2	-	-	-

Subjective Interpretation:

Among all building exterior features, façade openings, such as windows and doors seem to catch the most attention. A window, for example, connects the exterior to the interior. The exterior of any given building is to be appreciated for its details of craftsmanship and it justifies the high association with splendor. The effect of architecture from the exterior point of view is more apparent when what it stands for is explicitly recognized, such as a church or monumental landmark. An interior, on the other hand, is inspiring when the use of material and color is expressive or the flow of space is arranged dynamically.

Table 8
Results from search based on interior vs. impression
Table 9
Results from search based on exterior vs. impression

Although interior components can sometimes distract from the focus of the effect, they do not interfere with the psychological response towards spatial quality and orientation.

Review

Based on the sample database from Flickr, it is not statistically sufficient to draw conclusions but with the contribution of Trig'r users to fill in the missing information and expand the scope of the database, the enhanced database would be a collectively visual reflection on how people respond to a particular style of building and what attributes contribute to the "feeling" of a space.

CHAPTER FIVE

Discussion |

5.1. Design Research

Design research investigates the process of designing. Trig'r is a web-service integrated into the process of design by introducing the important use of photographic representation and the potential for crowd-sourcing design inspiration for architectural-related applications. The research results retrieved from Trig'r may be controversial since they do not reflect the architectural design discipline from a professional's value system and standard, but what is different about this type of research is that it challenges the boundary between the professionals and the general public. It reveals the extensive level of architectural design deliverables that is currently perceived by non-professionals. It is a research driven by the voice of people. Its inputs are valuable because it is free from commercial and political enterprises, and rather a reflection of current culture.

The science of architectural design lies in the hands of architects. It would be "a body of intellectually tough, analytic, partly formalizable, partly empirical, teachable doctrine about the design process" as described by Herbert Simon. Trig'r tries to investigate design methods in the use of visual elements through systematically categorizing a large visual depository online for the assessment of the development of design solutions to problems in the process of design. On a more general level, Trig'r introduces the language of architectural design to its users

and highlights the significance of emergent trends in architecture. It is a platform that would trigger emergent realization within the viewers from their own free interpretations based on their interaction with the visual data.

5.2. Understanding Fundamental Principles

5.2.1. Design Process

The process of designing a building, space or structure typically consists of four stages: (1) *concept development* and *programming*, (2) *schematic design*, (3) *design development*, and (4) *construction document*. This description is most certainly true if the designer only counts the stages of production in a design process. What is overlooked is the element that is simultaneously and consistently involved all the way through the process of design. It is persistently embodied in any design environment at any given time. It is the component that blends these phases into one another. I call it *critical observation*.

It is an ability to extract constructive information visually or verbally from any given collection of material and find what seems to be the best fitting solutions to the problems at hand. That is critical to the process of design development. It is part of a process that every designer inherits and an indispensable skill to gradually obtain over time.

In every stage of the design, there are decisions made and they become the foundation of the subsequent stage. It is non-linear in the sense that the design decision-making process is iterative; changes made in overall design influence the outcome design of detailed components and vice versa, detailed designs may

altogether suggest a different direction for how to conceptualize initial ideas.

To begin a design, the designer must understand her task. What is it that he/she is designing, what properties contribute to the make of it, and for whom is it designed? It is through researching and referencing that he/she can start to understand the full capacity of those questions and design decisions that emerge from them.

Moreover, for designers to avoid reinventing the wheel, they must stay up-to-date with the current issues that the profession and its clients are facing in order to make an appropriate proposal.

As a research tool, Trig'r provides feedback with flexibility and freedom while structuring architectural information in such a manner that lets the users keep in mind exactly what they initially were trying to accomplish while exploring the large information space presented online. Decisions are informed based on iteration through all possible combinations of variables. Cross-referencing leads to the final solution to a problem. Navigating through the interface teaches the understanding of architectural properties but also suggests that there are many different ways to approach the problem.

The architectural design process is a visually guided process. Imagery representation is used to describe a concept metaphorically, understand the spatial quality of a place, inspire others, illustrate design possibilities and invite narratives directed by the viewer.

5.2.2. Design Education

Perception = Interaction = Narratives

By explicitly classifying properties of architectural design, searching for photo references becomes much more informative and constructive. Trig'r presents all possible ways to research an architectural subject and it is meaningful through the study of taxonomic terms that Trig'r defines. Trig'r puts its users into an architectural perspective as soon as they start using it. It systematically exposes the user to the complexity of the architectural design discipline in its facet value and presents it visually through photographic representation. It is the easiest access for viewers to examine physical states and properties of those facets.

Furthermore, there is a need for communication between the professionals and those who use what they design. The formality of design language that professionals use among themselves can seem alienating to non-professionals. Therefore, the development of a visual dialogue between professionals and non-professionals is beneficial to the architectural discipline as a whole.

Every architect may choose a collection of his/her favorite visual vocabulary to use to communicate his/her design intention. This is where the designer can establish a connection between himself/herself and his/her audience, providing all information necessary for comprehension. Visual dialogue helps the professionals to understand what the users appreciate and are interested in.

Shifting from design to communicating the design to its audience is a delicate process. By examining the characteristics of online-

posted photos, an architect can tell if his/her design intention was well illustrated and communicated through his/her design. It is a shared story of an experience, a narrative that speaks for itself. The collective formulation of what design stands for and what aspect of it interests people is shown by how they represent their physical interaction with building through photography.

5.3. Reviewing the Framework

The proposed framework of Trig'r is organized based on three types of feedback that are generated and directed by both Trig'r and Flickr'r users: tags, photographs and level of interest (represented by photo count). This feedback plays an important role in informing the users while browsing search-results. The properties of their reviewing contents are structured in an orderly way so they can navigate through the large collection of visual information meaningfully.

The steps of researching an architectural subject using Trig'r are driven by numbers, representations and perspectives, which correspond to tags, photos, and photo counts respectively. By understanding the importance of these three dimensions of Trig'r, the user can develop a pair of critical eyes and extract information that is most relevant to their queries.

6.1. Thesis Achievement

The proposed model of Trig'r has a threefold significance. It demonstrates the potential use of user-generated architectural photographic content online by structuring its metadata in a meaningful way for use during the architectural design research process. It also illustrates possible methods for the design of a search interface that enables its user to quickly understand the properties of architectural design through refining and comparing it by its attributes. It demonstrates a possible underlying structure for problem-solving techniques to develop based on the collective collaboration of online community.

Design is a visually guided process. Images can influence and guide architects to different directions in the design process. Resolution, visual quality, and composition of images together play an important role. With this in consideration, the Flickr sample database was selected not only for the quality and dynamics of its images but also for the purpose of images: to be shared and inspire. There was a strong narrative embodied in every photo. It is also important for an architect or designer of any field to take a step back, disregard his expertise and professional beliefs, and listen to his audience. How do we experience light, space, form and tactility differently? Perhaps collective perception is the answer to those questions to provoke design creativity and exploration. It is crucial for designers to

stay open-minded and in tune with the current culture as they search for inspiration and set forth their vision for the future.

The proposed model of Trig'r reflects the principles of research: choosing a topic, refining a topic, searching for information, evaluating information sources and concluding with findings. Researching imagery references can accelerate the process of forming perspectives if it is the informative platform that encourages the user to search for more.

6.2. Future Work

The beta version of Trig'r proposed and implemented in this thesis stands in an in-between stage where its taxonomic framework can be broadened and expanded to serve across the whole spectrum of design fields or be even more specific for architectural practices purpose only, which would include facets for construction-related attributes and metaphorical terminology for concept development.

The sample collection of Flickr images is analyzed regarding its tags alone. More aspects of the metadata could be extracted and further analyzed to support the claim that there are patterns to how the combined use of text and images is critical to express a certain type of perceptive and feeling about a place. What is there about experience and perception of a place that images or text cannot fully describe alone? Is there a structural relationship between the use of image and of text? An interface design would introduce a story-telling feature for architectural design theory and experience.

This version of the implementation did not include any machine-vision based algorithms. Image and content recognition such as

feature extraction could be a potential use to automate tags for sorting. Moreover, the set of taxonomic properties of architectural work was defined at a preliminary stage due to the nature of a tag. Implementing learning algorithms to reveal patterns of user-generated text and tags may uncover some insights into the next generation of digital memo, which will better encapsulate the complexity of human perception and experience in a non-verbal way.

For the purpose of this version, online-posted images and photographs are the only source used to build the system. It could benefit the designer even more if the system invited more types of feedback from users, such as video, audio, and the possibility for them to draw or sketch on images to express their ideas visually.

The design discipline is a vast collection of fields and focused expertise and interests, but what is universal is that they all share fundamental values and principles of design. Trig'r, imagined as a platform with a large source of visual information, offers an interactive and encouraging environment to provoke visual dialogues among designers from all backgrounds. This will transform the structure of the design professions into an even more interdisciplinary, motivational and challenging industry. Trig'r can serve as a guide book/illustration manual to any design-related project. It can not only guide research for inspiration but also enable users to brainstorm visually while understanding the needs of their audience.

Image Sources & References |

| Image Sources

All images are by the author unless otherwise noted.

Figure 2-1

Google Image Search Webpage

<http://images.google.com/images?hl=en&q=architecture&gbv=2&aq=f&oq=&aqi=g10>

Figure 2-2

Picsearch Webpage

<http://www.picsearch.com/search.cgi?q=architecture&color=both&anim=both&size=1p&aui=1&orientation=all&t=YHNxSV3tDdHxmJD8YAeZdcnx6pxHmfz2s9E5OqGYaEM%3D&cols=6&thumbs=18>

Figure 2-3

Macworld Webpage

http://www.macworld.com/article/140547/2009/05/itunes_keyboard_shortcuts.html

Figure 2-4

RAVE Project Webpage

<http://idl.ils.unc.edu/rave/history.html>

Figure 2-5

Flamenco Fine Arts Search

<http://orange.sims.berkeley.edu/cgi-bin/flamenco.cgi/famuseum/Flamenco>

Figure 2-6

Flickr Webpage

<http://www.flickr.com/search/?q=architecture>

Figure 2-7

Photosynth Webpage

<http://photosynth.net/>

Figure 2-8
Photo Tourism Webpage
<http://phototour.cs.washington.edu/>

Figure 2-9
The World's Eyes Webpage
<http://senseable.mit.edu/worldseyes/visuals.html>

Figure 2-10
Mapping the World's Photos Webpage
http://www.cs.cornell.edu/w8/~crandall/maps/map_na.png

Figure 3-4
[Edited] Image titled *frank-gehry_AGO_opening_02* by Flickr
Author wvs / Sam Javanrouh
<http://www.flickr.com/photos/wvs/3030820297/>

Figure 3-6
Image titled *de young twisted tower* by Flickr Author shapeshift
/ David Pham
<http://www.flickr.com/photos/shapeshift/970741241/>

Figure 4-1
Flickr Search Webpage

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