

Introduction to Media Computing

Lecture 1: Introduction

Lecturer: Zechao Li (李泽超)

Outline

- **Objectives and Expected Outcome**
- **Course Arrangements**
- **History of Media Search Engines**
- **Applications of Media on the Web**
- **Summary**

Why?

- Multimedia is cool
 - Media -> Multimedia
 - Everywhere
 - Requires broad knowledge in mathematics, signal processing, communications, networking, software, hardware,
 - You are paid to watch movies in your office !
- Job opportunities
 - Multimedia is a booming industry
 - in the metro Vancouver area
 - Tons of opportunities created by next-generation standards and emerging applications:
 - JPEG/JPEG 2000
 - MPEG-1/2/4 H.264/265/HEVC 4K UHD 3D/freeview
 - 3G/4G/5G mobile communications
 - Multimedia-enabled smartphone, tablets
 - Social media, Cloud media, Crowd media
 - Online gaming

Aims and Objectives:

- This module introduces students to the concepts, issues, design, implementation, standards and applications of multimedia technologies:
with special emphasis on media representation, standards, content analysis and search
- The module is divided into 2 parts:
 - 1) Fundamentals and Standards of Digital Media
 - 2) Text, Image and Audio Search

Fundamentals & Standards of Digital Media:

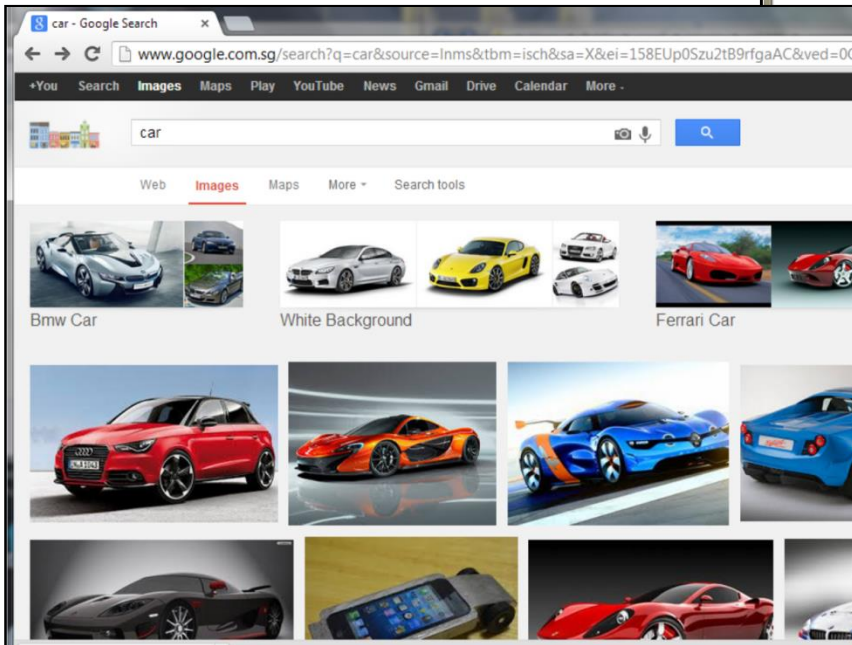
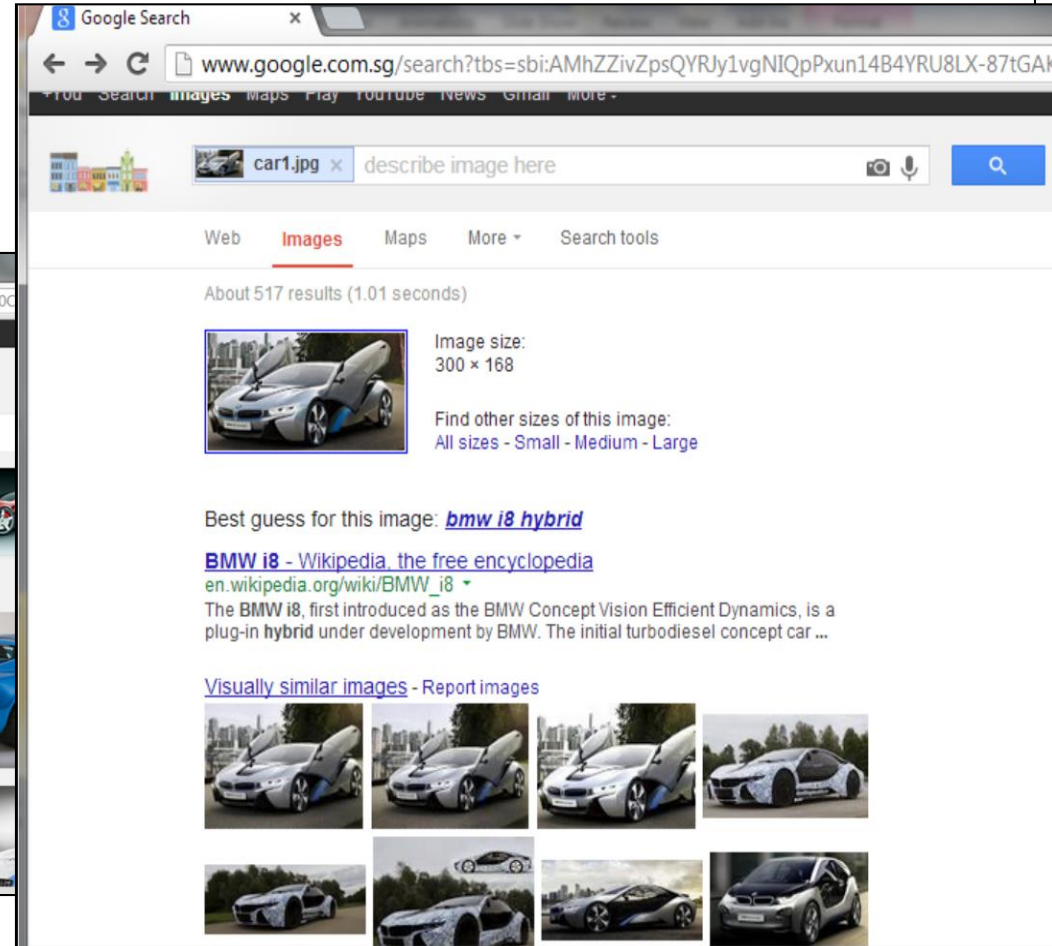
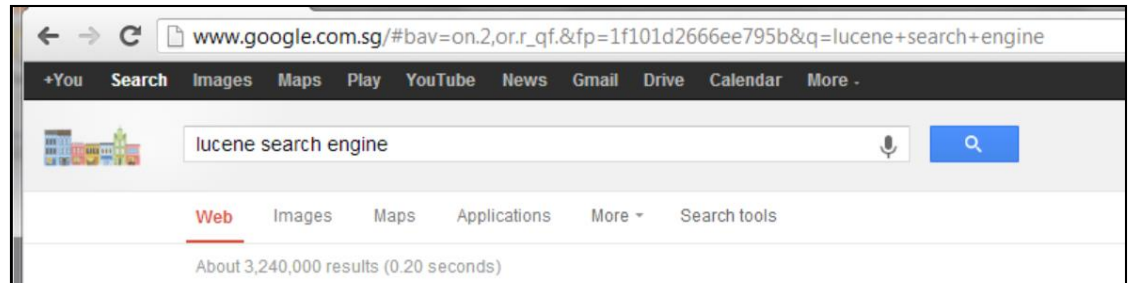
- Most important development in media processing is the standardization of audio, image and video standards, in terms of MP3, JPEG and MPEG
 - They are used everywhere, and promoted the wide spread use of audios/images/videos on the Web
 - Students must have fundamental understanding of the compression schemes, and their strengths and limitations
- This module will cover:
 - Fundamentals of digital media
 - Compression techniques
 - Audio standards
 - JPEG, MPEG (for movies) and H26x (for video conferencing)

Text, Audio and Image Search:

- Search is a fundamental tool for information access and management, be it on the Web or on local file system
- Search, esp. media search, is becoming active (both commercial and in research) because of the exponential growth of social media contents
- Issues to be discussed:
 - Representation of text, audio and image content
 - Similarity match between a query and the database items
 - Bridging of semantic and user intention-gaps in retrieval
 - Backend architecture
 - Search engine design and implementation

Examples of Media Search -1

- Google/ Bing/ Baidu Search Engines: Support text and image search etc.



Examples of Media Search -2

- Search engines developed at NUS:
 - www.nextcenter.org

The top screenshot shows the Image search engine interface with the search term 'singapore'. The search bar is at the top, and the results are displayed in a grid. The search engine is 'Image' and the search results are 'About 1,353 results (0.0040 seconds)'. The search engine is 'Image' and the search results are 'About 1,353 results (0.0040 seconds)'. The search engine is 'Image' and the search results are 'About 1,353 results (0.0040 seconds)'.

The bottom screenshot shows the Image search engine interface with the search term 'singapore'. The search bar is at the top, and the results are displayed in a grid. The search engine is 'Image' and the search results are 'About 408 results (6.642 seconds)'. The search engine is 'Image' and the search results are 'About 408 results (6.642 seconds)'. The search engine is 'Image' and the search results are 'About 408 results (6.642 seconds)'.

Statistics	Crawled	Indexed
Twitter	12,919,261	2,034,782
Facebook	97,670,193	28,766,866
Google+	78,967,657	5,147,032
LinkedIn	76,304,513	2,571,918
YouTube	297,158	31,984
Instagram	779,584	0
Amazon	1,611,928	135,526
Reddit	2,257,883	11,000
DeviantArt	254,816	0
Total	271,052,993	38,697,855

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Reddit	2,257,883	11,000
DeviantArt	254,816	0
Total	271,053,039	38,699,108

Examples of Media Search -3

- Search engines developed at NUS:
 - www.visenze.com (An example of vertical domain visual search)

The screenshot displays the Visenze.com visual search interface. On the left, a reference image shows a woman holding a Gucci Sukey Original GG Large Tote. Below this image are filter options for 'Clothing', 'Bags', and 'Shoes', with 'Bags' selected. A 'Color Filter' section shows a grid of color swatches, with 'Clear' and 'OK' buttons at the bottom. The main area features a grid of 18 handbags, each with a caption and price. The bags are arranged in three rows of six. The first row includes Gucci Sukey Original GG Large Tote, Gucci GG Twins Large Hobo, Scarlett Hobo, Gucci Sukey Medium Messenger Bag, Sukey Tote, and Heart Bit C. The second row includes Tory Burch Large Straw Square Tote, New Ladies Web Large Hobo, Bella Hobo, Sukey Tote, GG Twins Large Hobo, and Gucci Sukey. The third row includes Sukey Tote, Gucci Sukey Original GG Medium Hobo, Gucci Dressage Medium Tote, Scarlett Studded Interlocking G Tote, Marc By Marc Jacobs Coated Canvas Inter Static Nova, and Sukey. Navigation arrows are visible at the top right of the grid.

Similar to

Clothing
Bags
Shoes

Color Filter

Clear OK

Gucci - Sukey Original GG Large Tote
SGD \$385.50 - Saksfifthavenue

Gucci - GG Twins Large Hobo
SGD \$385.50 - Saksfifthavenue

Scarlett Hobo - Gucci

Gucci - Sukey Medium Messenger Bag
SGD \$357.65 - Saksfifthavenue

Sukey Tote - Gucci

Heart Bit C - Gu

Tory Burch Large Straw Square Tote | SHOPBOP
\$225.00 - Shopbop

New Ladies Web Large Hobo With Engraved Gucci Script - Gucci

Bella Hobo - Gucci

Sukey Tote - Gucci

GG Twins Large Hobo With Interlocking G Ornaments - Gucci

Gucci - Sukey
SGD \$246.25 - S

Sukey Tote - Gucci

Gucci - Sukey Original GG Medium Hobo
SGD \$322.84 - Saksfifthavenue

Gucci - Dressage Medium Tote
SGD \$657.03 - Saksfifthavenue

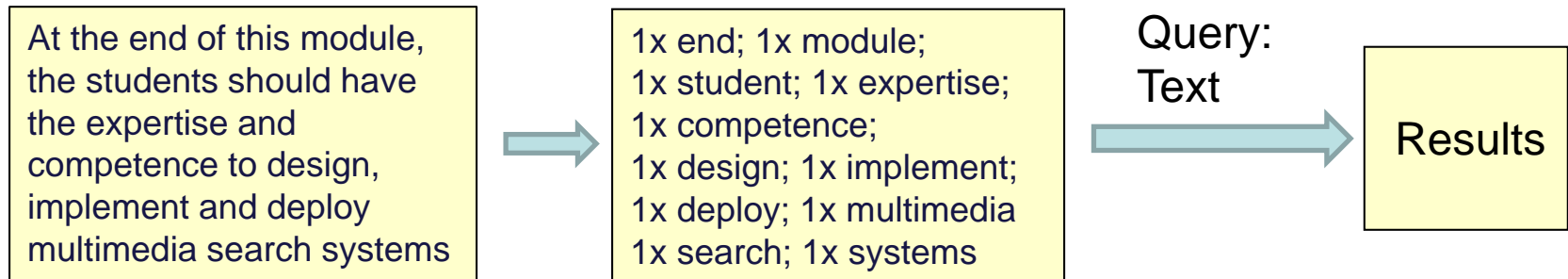
Scarlett Studded Interlocking G Tote - Gucci

Marc By Marc Jacobs - Coated Canvas Inter Static Nova
SGD \$26.35 - Saksfifthavenue

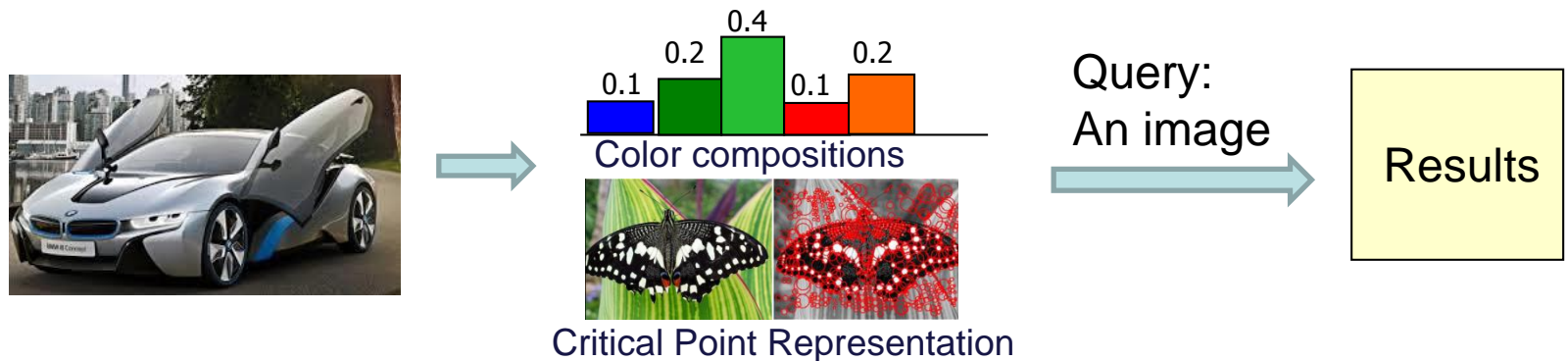
Sukey - Gu

What are the Technologies Behind these Search Engines?

- Text representation and matching



- Image representation and matching



- Extract object-level representation (for vertical domain)
- Indexing for efficient matching and retrieval

Teaching Outcome:

At the end of this module, the students should have the expertise and competence to design, implement and deploy multimedia search systems, with a good understanding of the architecture of modern search engines

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Course Schedule (1)

Lecture/Tutorial Topics
L1: Introduction to MM Systems
L2: Brief Intro to Text Retrieval (+RF)
L3: Image Content Analysis (Feature Extraction & Similarity Measures)
L4: Concept-based Image Retrieval
L5: Indexing and Search Architecture
L6: Basic Concepts in Digital Multimedia
L7: Intro to Audio Processing
L8: Image Transformation and Filters

Course Schedule (2)

Lecture/Tutorial Topics
L8: Image Transformation and Filters
L9: Compression Algorithms [7,8]
L10: Introduction to JPEG [4,9]
L11: Color Model and Color JPEG
L12: MPEG Model [10,11]
L13: : H261 [10,12] & Future Trends

References:

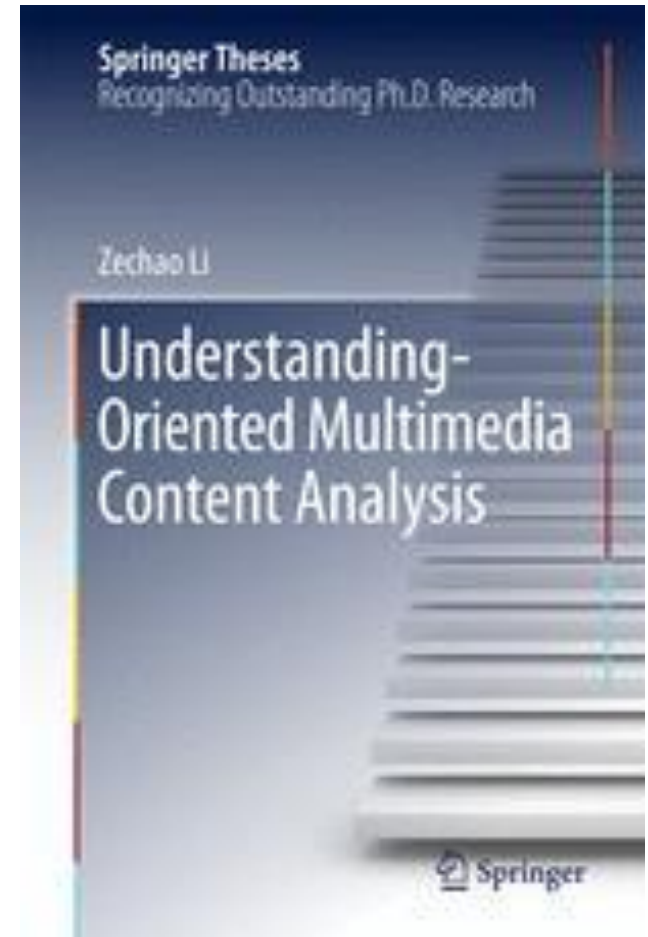
- **MainText** (on media standards):
 - Z.N. Li and M.S. Drew (2004). Fundamentals of Multimedia. Prentice Hall
- **Reference Text:**
 - Jennifer Burg. The Science of Digital Media. Pearson Prentice-Hall, 2009
 - Alberta Del Bimbo. Visual Information Retrieval. Morgan Kaufmann Publishers, 1999
 - Yuhang Zhang. Content-based Image Retrieval. LAP Lambert Acad Publisher, 2010.
 - Price R., Chua Tat-Seng, Al-Hawamdeh S. (1992). Applying Relevance Feedback to a Photo Archival System. Journal of Information Science, 18: 203-215.
 - Brin S & Page L (1998). The anatomy of a large-scale hypertextual web search engine. 19 pages

References:

- **MainText:**

- Zechao Li. **Understanding-Oriented Multimedia Content Analysis**. Springer 2017

- <https://link.springer.com/content/pdf/10.1007%2F978-981-10-3689-7.pdf>



About Myself

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 - Education
 - 2004-2008, University of Science and Technology of China
 - 2008-2013, Institute of Automation, Chinese Academy of Sciences
 - 2013-Date, Nanjing University of Science and Technology
 - 智能媒体分析实验室 <http://imag.njust.edu.cn/>

**Any Questions Before We
Proceed??**

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The web is really large

- 100 B pages
- Lots of dynamically generated content
- New pages get added all the time
- The size of the blogosphere doubles every 6 months
 - Technorati has 50M+ blogs
- Yahoo deals with 12TB of data per day (according to Ron Brachman)
- The biggest addition of info is the social network sites
 - Every day, Facebook users share 2.3 billion pieces of content and upload 250 million photos
 - Twitter users post 190 million tweets
 - Many tweets have images (1/3 in Weibo)

Examples of search engines

- Conventional (library catalog).
Search by keyword, title, author, etc.
- Text-based (Lexis-Nexis, Google, Yahoo!, Bing, Baidu).
Search by keywords. Limited search using queries in natural language.
- Multimedia (QBIC, WebSeek, SaFe, Major Search Engines)
Search by visual appearance (shapes, colors,...).
- Question answering systems (Ask, NSIR, Answerbus)
Search in (restricted) natural language
- Clustering (Lesystems (Vivísimo, Clusty)
- Many research systems
- Social media search: Twitter/Weibo search interfaces..
Problem in indexing live postings – not all live posts are indexed

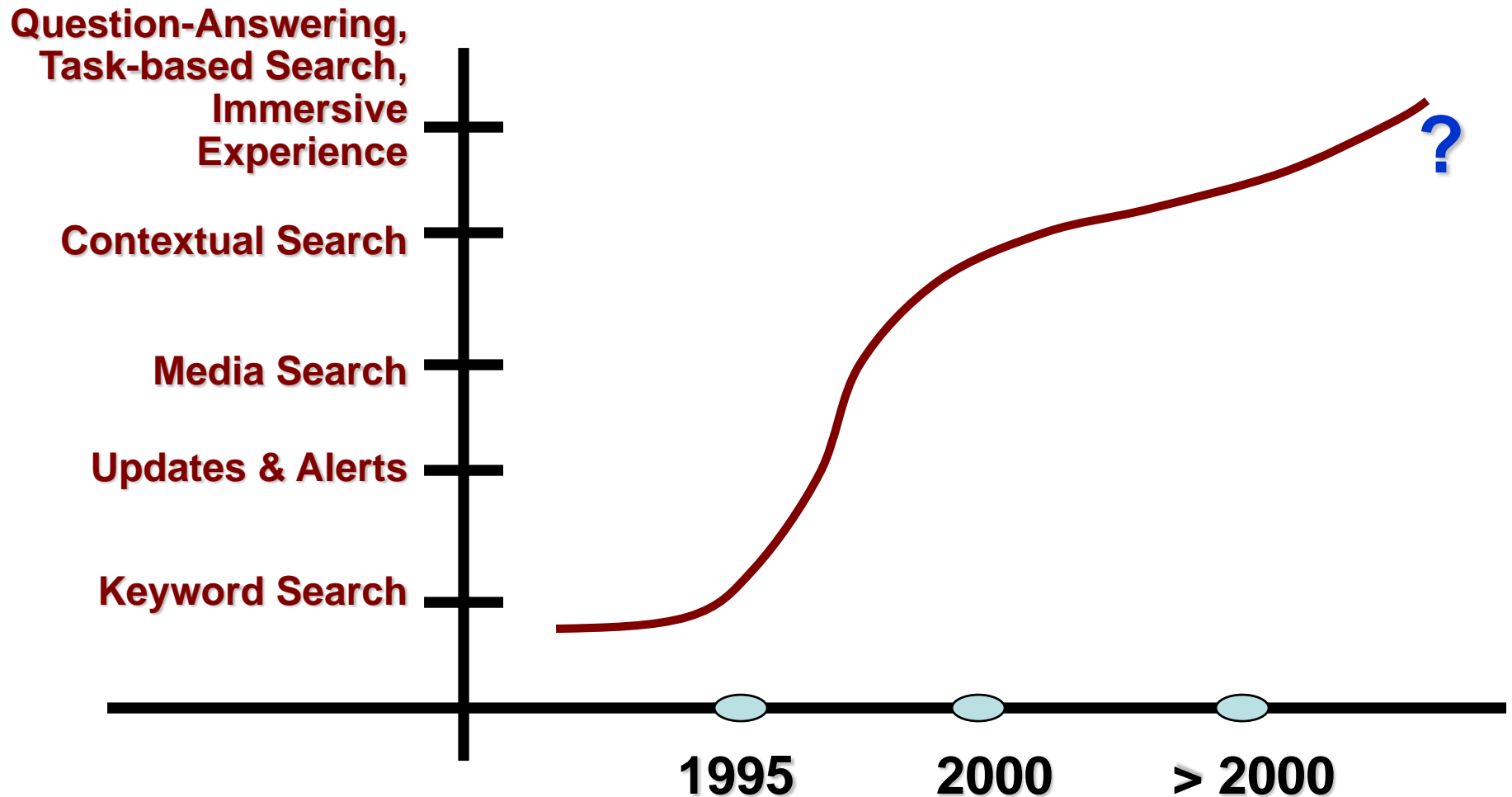
What does it take to build a search engine?

- Decide what to index
- Decide what features to index
- Gather data
- Index it (efficiently)
- Keep the index up to date
- Provide user-friendly query facilities

What else?

- Understand the structure of the web for efficient crawling
- Understand user information needs
- Preprocess text and other unstructured data
- Cluster data
- Classify data
- Evaluate performance

Development of Web Search



- Current Web is text-based and document-oriented
- Future is going to be multimedia and information oriented

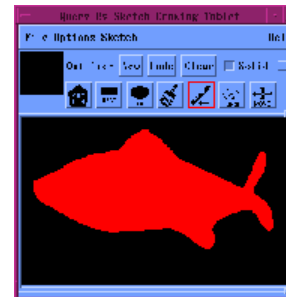
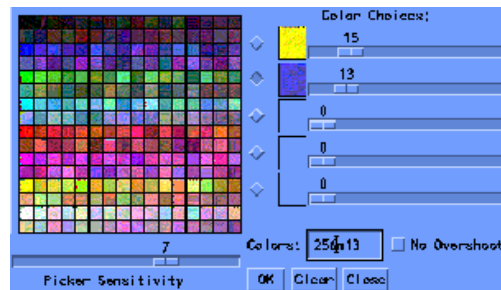
Text-Based Media Search



- Most commercial image search systems allow user to issue query as a list of keywords - **Query by keywords**
 - Search is performed on basis of textual tags annotated by users, which tend to be incomplete and ambiguous
 - Moreover, most users cannot express the search intention clearly

Early Media Search Systems

- Use of media contents in search evolved in early 90s
- QBIC of IBM is an early example (Flickner et al '95)
 - First complete commercial CBIR System that supports Query by Image Content
 - Uses color, texture, shape features
 - Support search by colors, shapes, sketch and text - primitive

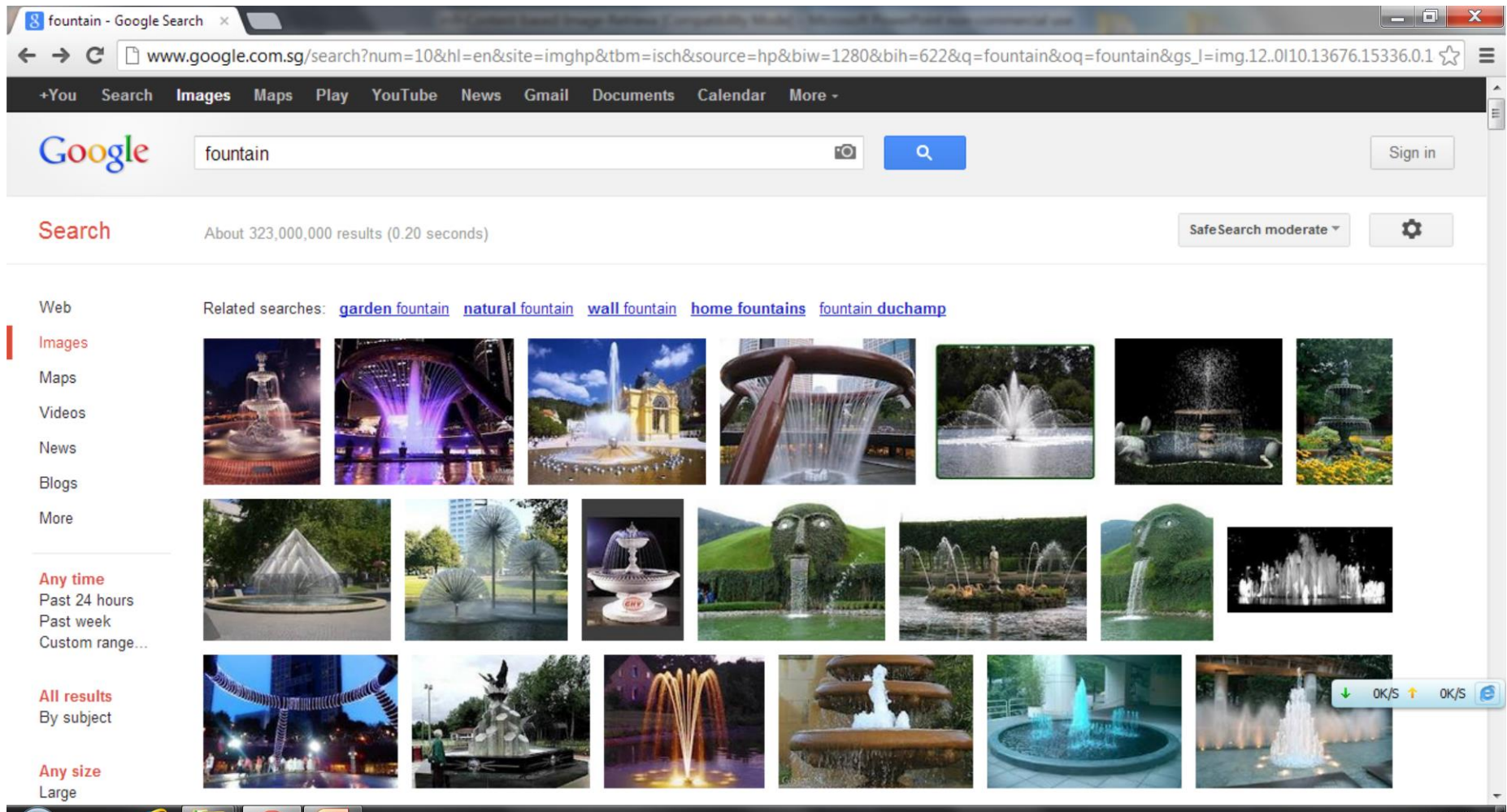


CBIR in Main Stream Search Engines -1

- More recently, content-based media search has been integrated into main stream search engines
 - Uses a combination text and content-based media search functions
 - Media contents used include: color, texture and visual keywords based on local features such as SIFT
 - Media analysis is secondary to text in retrieval

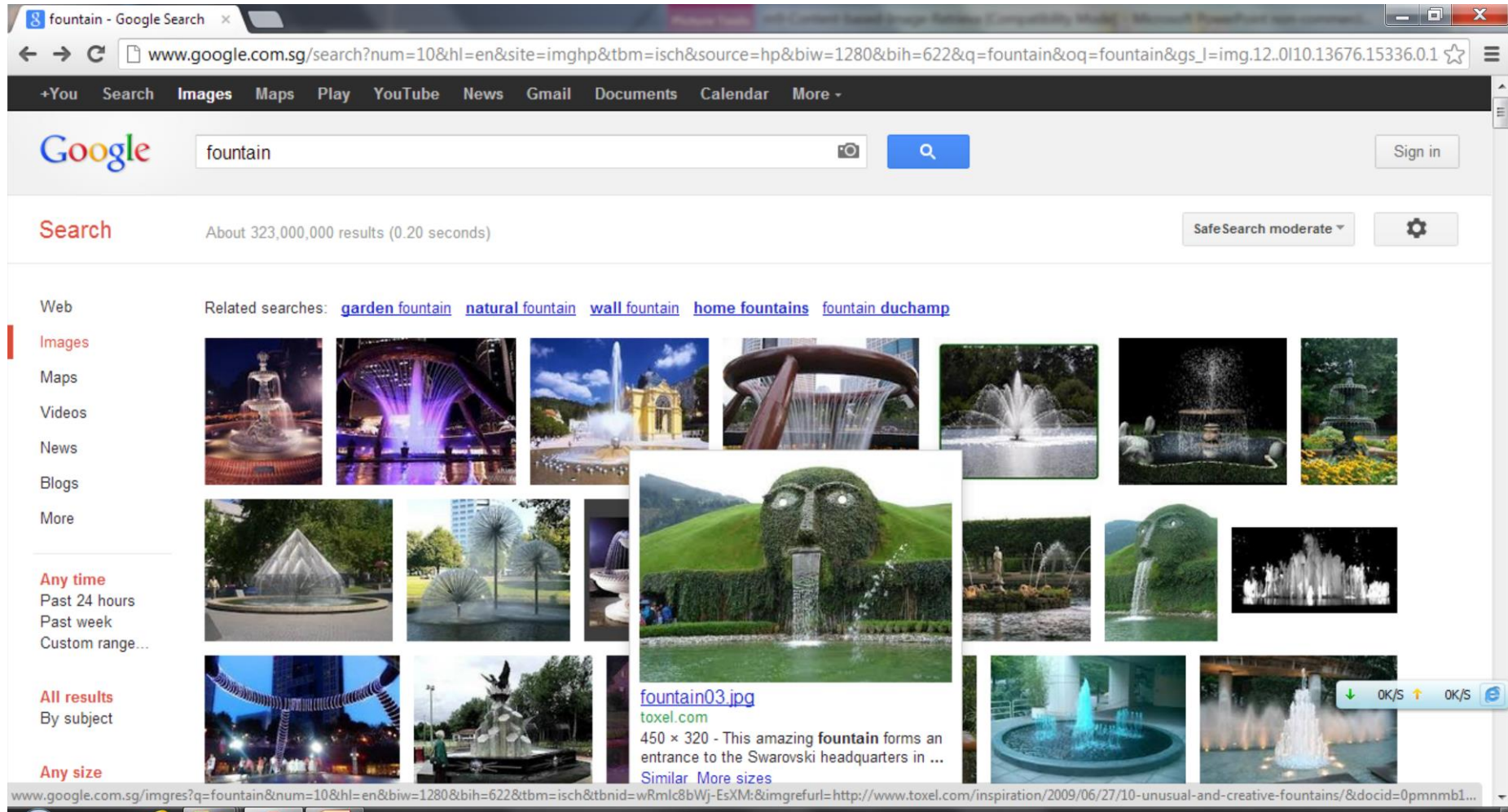
Google Image Search -1

- Google has integrated Content-based Media Search



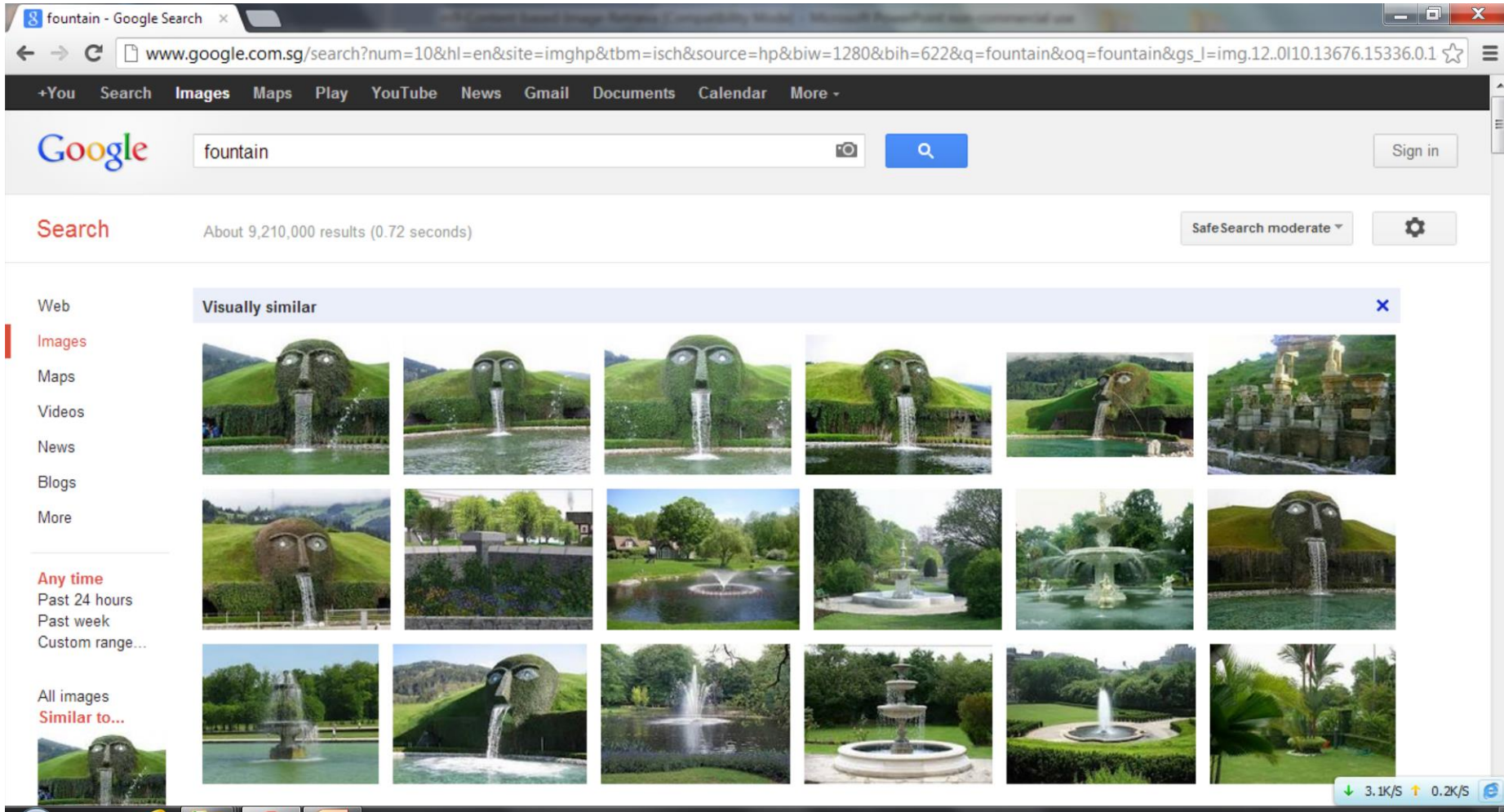
Google Image Search -2

- Google has integrated Content-based Media Search



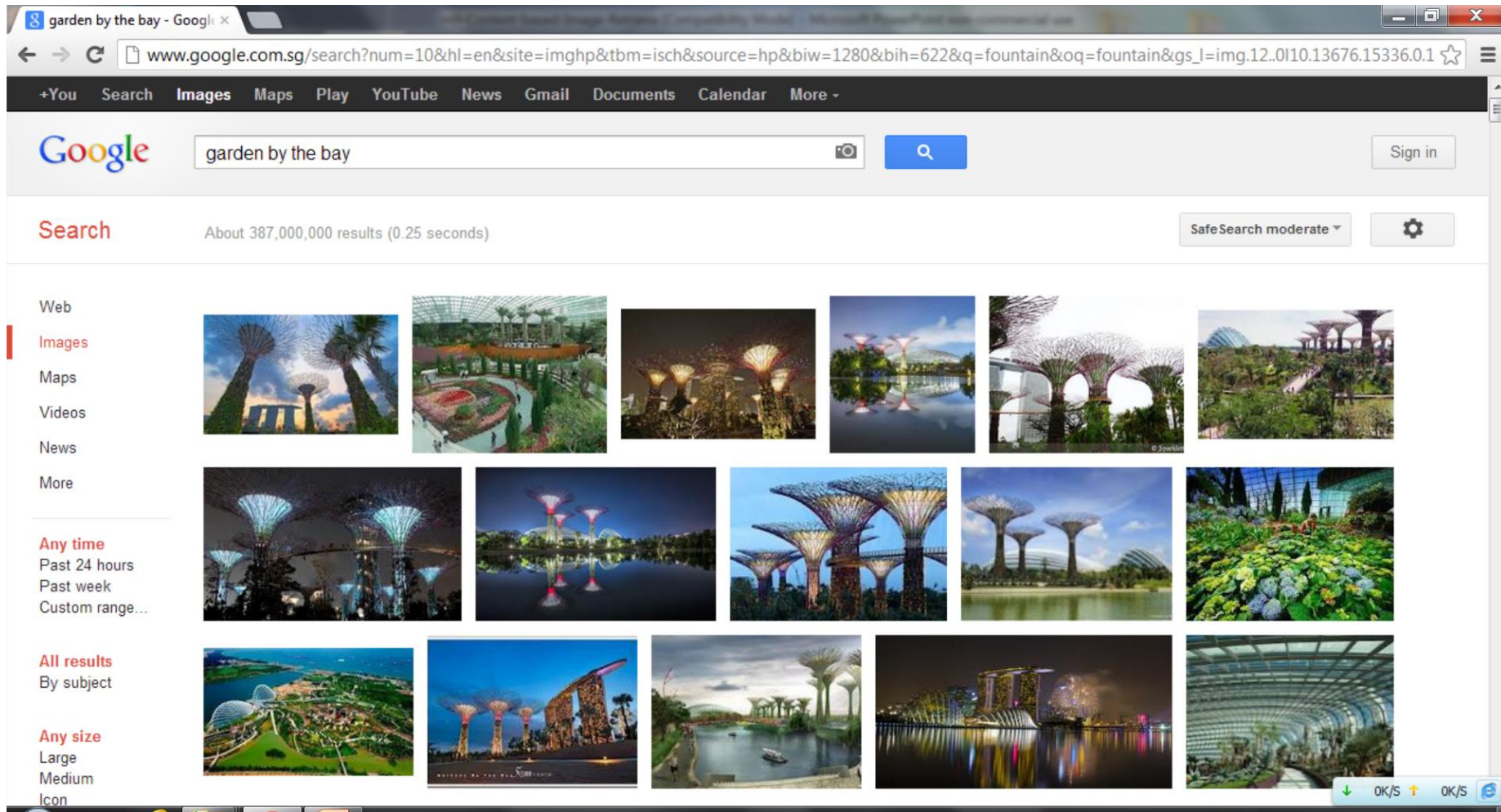
Google Image Search -3

- Google has integrated Content-based Media Search



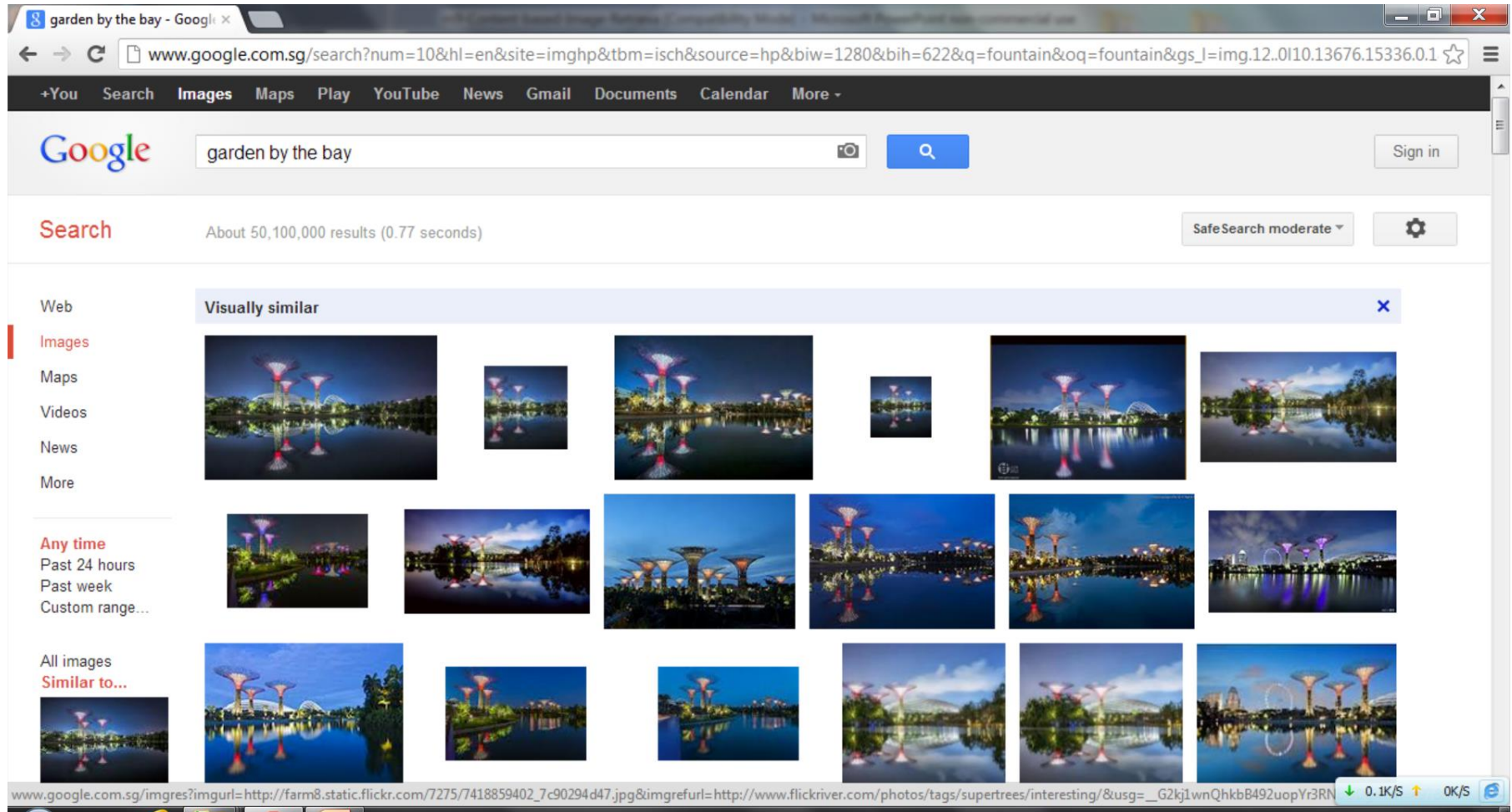
Google Image Search -4

- Google has integrated Content-based Media Search



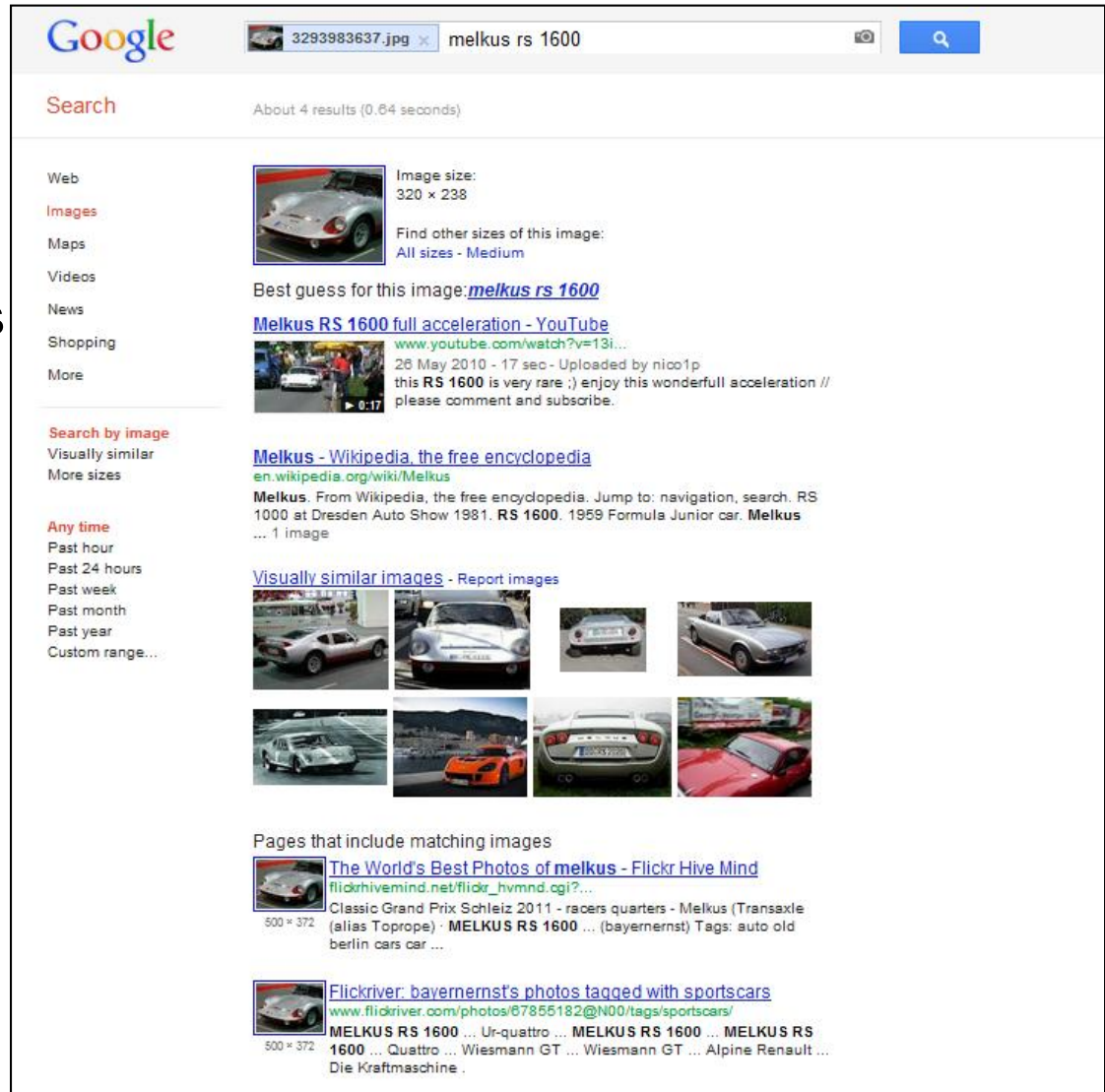
Google Image Search -5

- Google has integrated Content-based Media Search

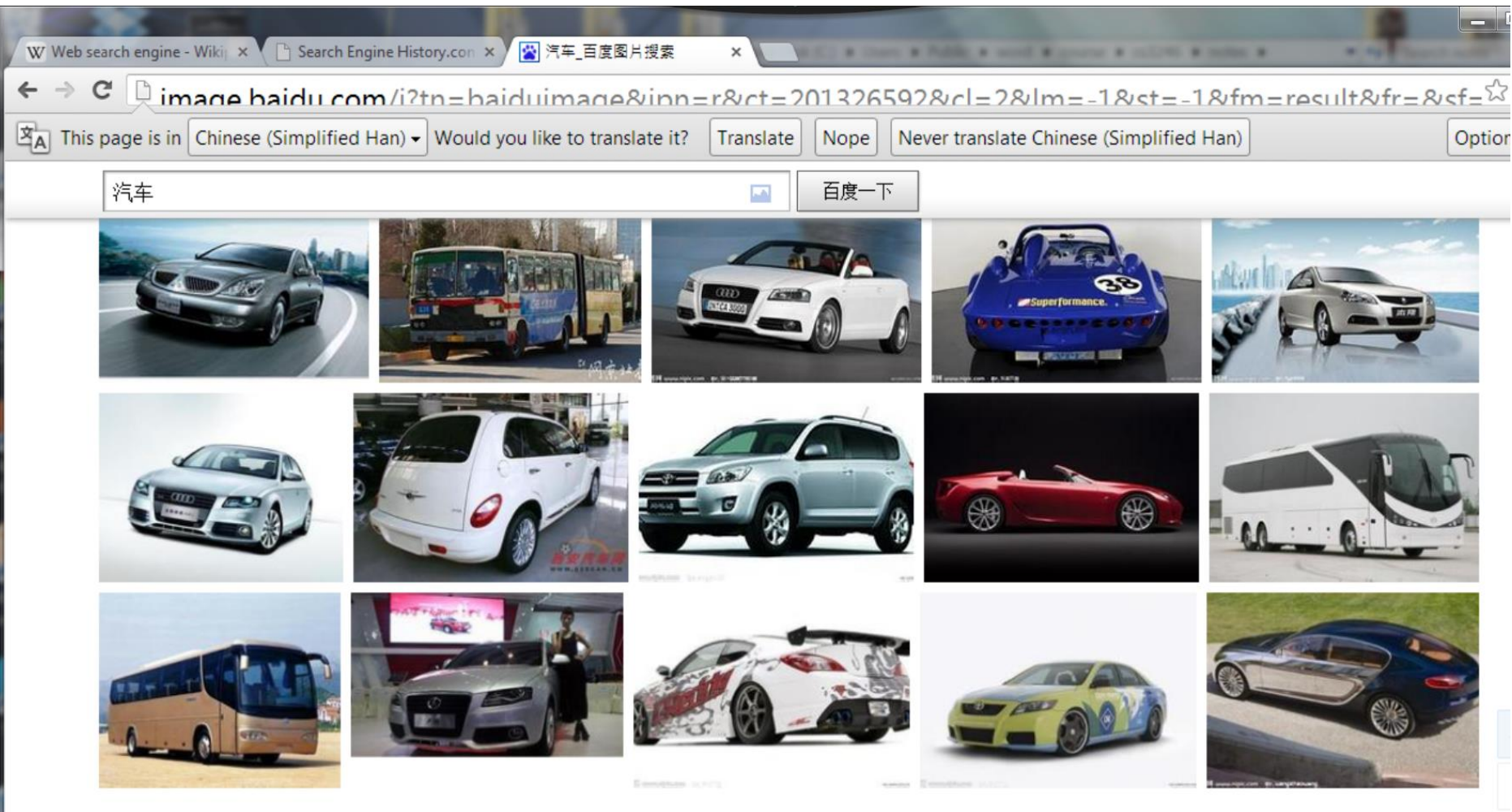


Google Image Search -6

- In fact, Google appears to be even more intelligent!!
- Approach:
 - Looks for near-duplicates
 - Use their text features to describe input image
 - Works because they have large number of samples
- Bing & Baidu have also introduced content-based search with improved quality



Baidu Image Search -1



Baidu Image Search -2

Upload image Query

Google Search 百度识图-上传图片 查询

stu.baidu.com/i?ct=2&tn=shituresultpc&pn=0&rn=10&querysign=348395906,2049605253

This page is in Chinese (Simplified Han) Would you like to translate it? Translate Nope Ne

Baidu 图片 新闻 网页 贴吧 知道 音乐 图片 视频 地图 百科

全部 相似图片

 找到该图片不同尺寸200张
原图尺寸:350x189
筛选该图片的其他尺寸:
全部尺寸 大尺寸 中尺寸 小尺寸 精确尺寸 »

识图猜测: [rav4](#)

[rav4](#) 百度百科

RAV4是丰田公司微型多功能越野车家族中的基本型车,其名称来自“Recreational Active Vehicle”的缩写,意为“四轮驱动的休闲运动车”。RAV4于1994年在日本问世,销量为丰田公司月销往美国。RAV4单元式的车身结构在多功能越野车中独树一帜。

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<http://baike.baidu.com/view/652882.html?from=shitu>

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rav4 2.4豪华升级版售24.68万-25.68万

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丰田rav4 购车最高尊享11000元现金优惠

丰田rav4 购车最高尊享11000元现金优惠

<http://news.cheshi.com>



550x296

维修保养方面,丰田 rav4 整车质保为2年或5万公里,每隔4000公里做一

对于一款合资品牌suv车型来说,rav4的保养费用和竞争对手相比属于中等水平。

<http://www.xwcsj.com>



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国产大众cc上市 为华南战略提供产品支撑

(南方都市报)

<http://www.citygf.com>



背后意义更大:为大众华南战略提供产品支撑

Equivalent Results from Google Image Search

Google Search

www.google.com.sg/search?tbs=sbi:AMhZZitdeSnG4dFqrq_1YGGIU6nQGMUa

This page is in Chinese (Simplified Han) Would you like to translate it? Translate

+You Search Images Maps Play YouTube News Gmail More -

Google car2.jpg x 丰田 rav4

Web Images Maps More Search tools

About 476 results (0.57 seconds)




Image size: 350 x 189
No other sizes of this image found.

Best guess for this image: [丰田 rav4](#)


[丰田RAV4 - 二手车交易市场 - 51汽车](#)
2car.51auto.com/s2rav4/

A description for this result is not available because of this site's robots.txt - learn more.

[丰田rav4新款 Soowang Network Pte Ltd](#)
www.soowangsearch.com/s.aspx?wd=丰田rav4新款

The contents provided herein http://www.soowangnews.com is an automated generated result based on your input of keyword and search perimeters.

[Visually similar images - Report images](#)



Visually similar images - Report images



Pages that include matching images

天津一汽丰田汽车有限公司

[www.tftm.com.cn/english/cpgc/rav4/peibei.htm](#)
720 x 159 - Outstanding obstacle performance of RAV4 comes from advanced 4WD system. Electric-control coupling device can judge information concerning driving speed ...

太原一汽丰田RAV4|太原一汽丰田RAV4经销商|太原一汽丰田RAV44S ...

[www.0351auto.com](#) > 整车销售 > Translate this page
283 x 192 - 本站为您提供一汽丰田RAV4|太原一汽丰田RAV4|太原一汽丰田RAV4汽车|太原一汽丰田RAV4车型|太原一汽丰田RAV4经销商|太原一汽丰田RAV44S店|太原一汽 ...

RAV4 丰田RAV4_RAV4的图片 搜狐汽车 - 车型 - 搜狐

[db.auto.sohu.com/model-1639_pic.shtml](#) > Translate this page
170 x 92 - 丰田RAV4的图片,搜狐汽车为你提供丰田RAV4相关的丰田RAV4报价、丰田RAV4参数、丰田RAV4图片、丰田RAV4配置、丰田RAV4资讯、丰田RAV4油耗、丰田RAV4 ...

丰田RAV4 - 深圳汽车团购- 本地宝

[qiche.sz.bendibao.com/tuan/98.htm](#) > Translate this page

CBIR in Main Stream Search Engines -2

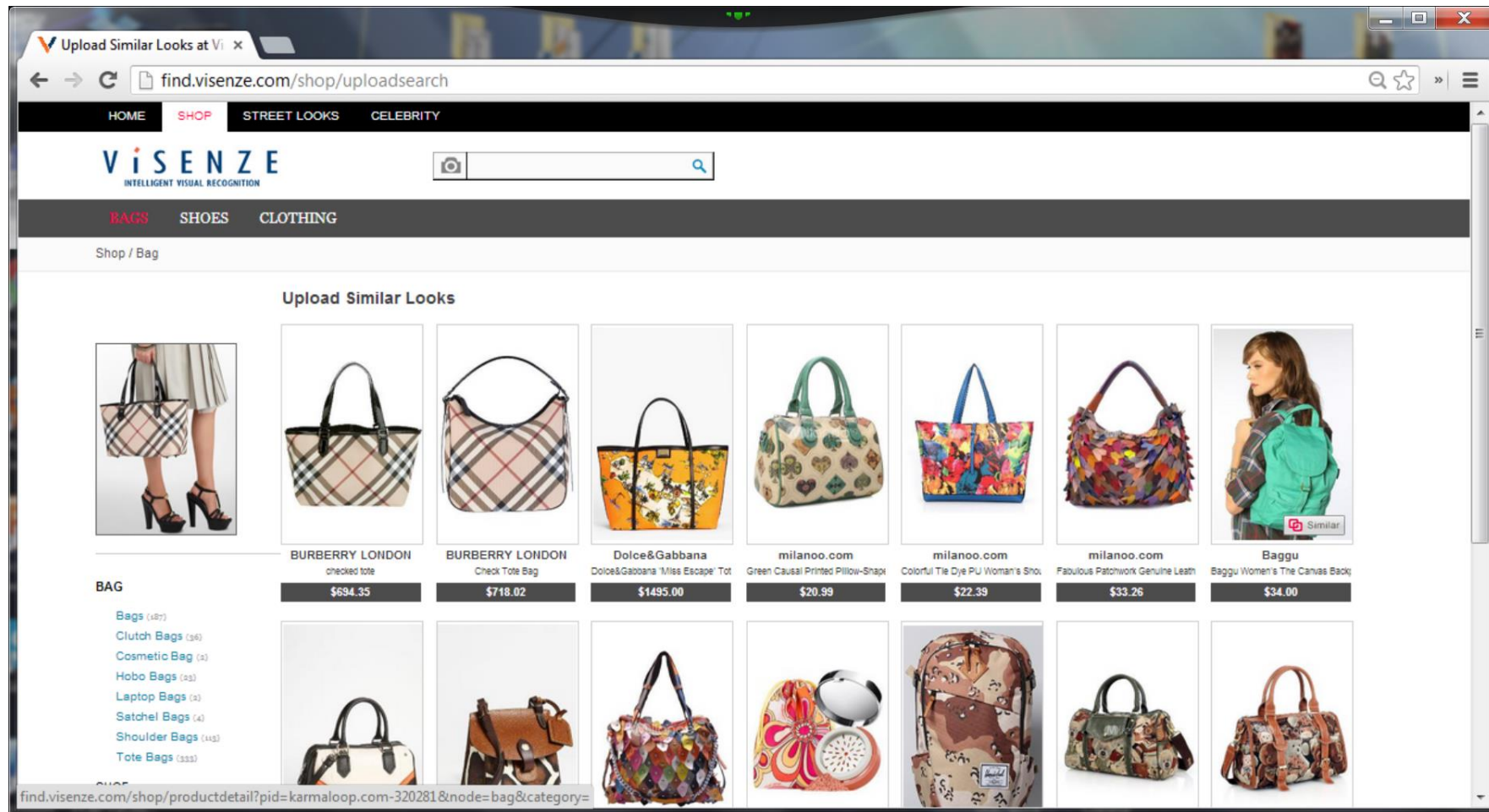
- More recently, content-based media search has been integrated into main stream search engines
 - Uses a combination text and content-based media search functions
 - Media contents used include: color, texture and visual keywords based on local features such as SIFT
 - Media analysis is secondary to text in retrieval
- Why after almost 20 years since QBIC?
 - Local visual features is sufficiently robust
 - Large amount of social annotations available
 - Advances in indexing strategy and storage permit large visual index to be searched efficiently

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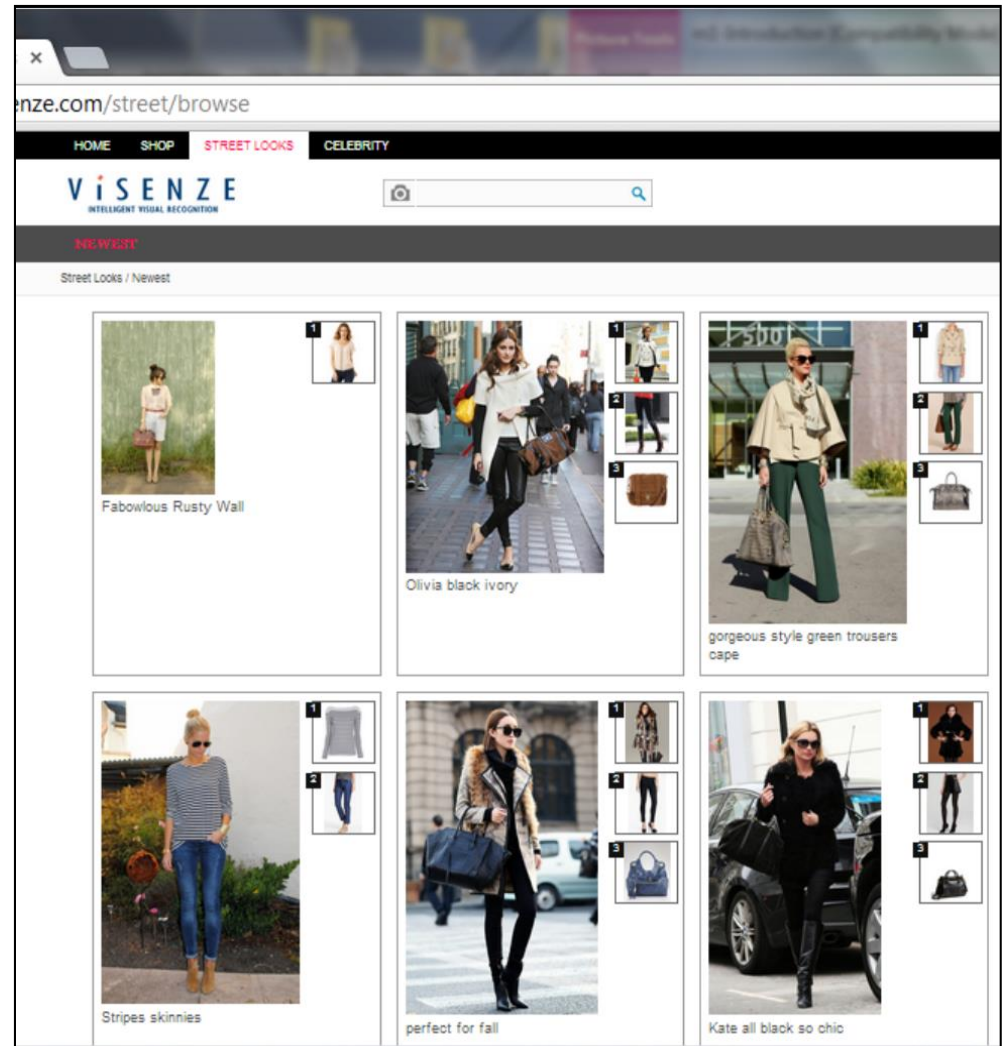
Towards Object-based Search in a Vertical Domain: ViSenze -1

- Start-up from NUS (www.visenze.com)
- Specialized in visual fashion search (snap-search-browse)



Towards Object-based Search in a Vertical Domain: ViSenze -2

- Extraction of fashion contents and matching to products from street photos
- Piloting with big e-commerce and affiliate marketing sites



Reverse Search Engine

- Goolge, Baidu & ViSenze are examples of reverse search
- TinEye: A Reverse Image Search Engine
 - It finds out where an image came from, how it is being used
 - Based on copy and near duplicate detection technology
 - Purely content-based search on database of over 3 billion images

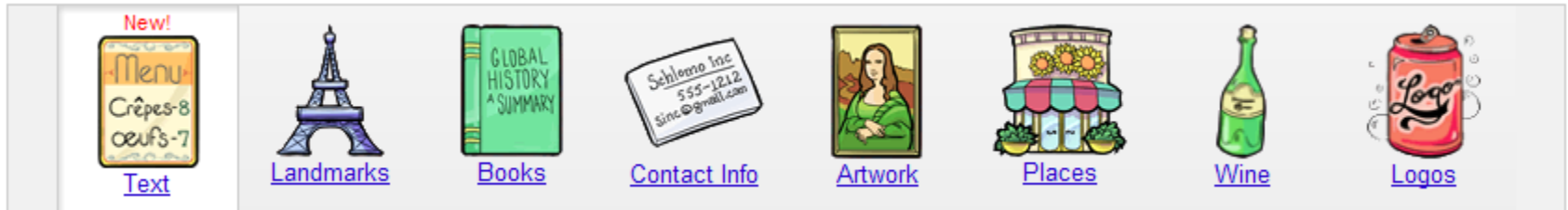




Google Goggles

Use pictures to search the web.

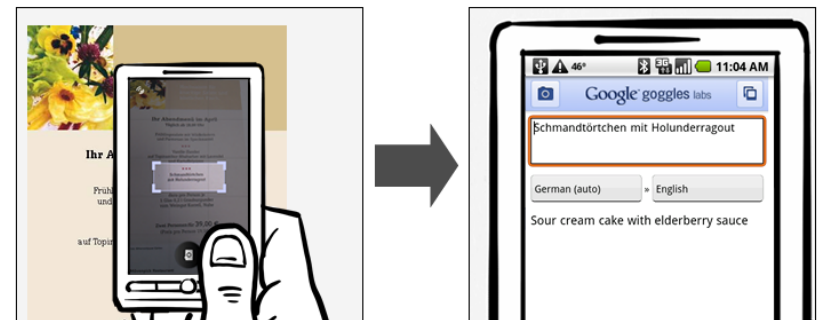
- List of objects searchable via Goggle
 - Snap pictures and get answers



- More details of this Landmarks



- Give me the English translation of this menu?



- Key technologies: OCR, logo detection, image matching...



Many other similar systems in the market !!

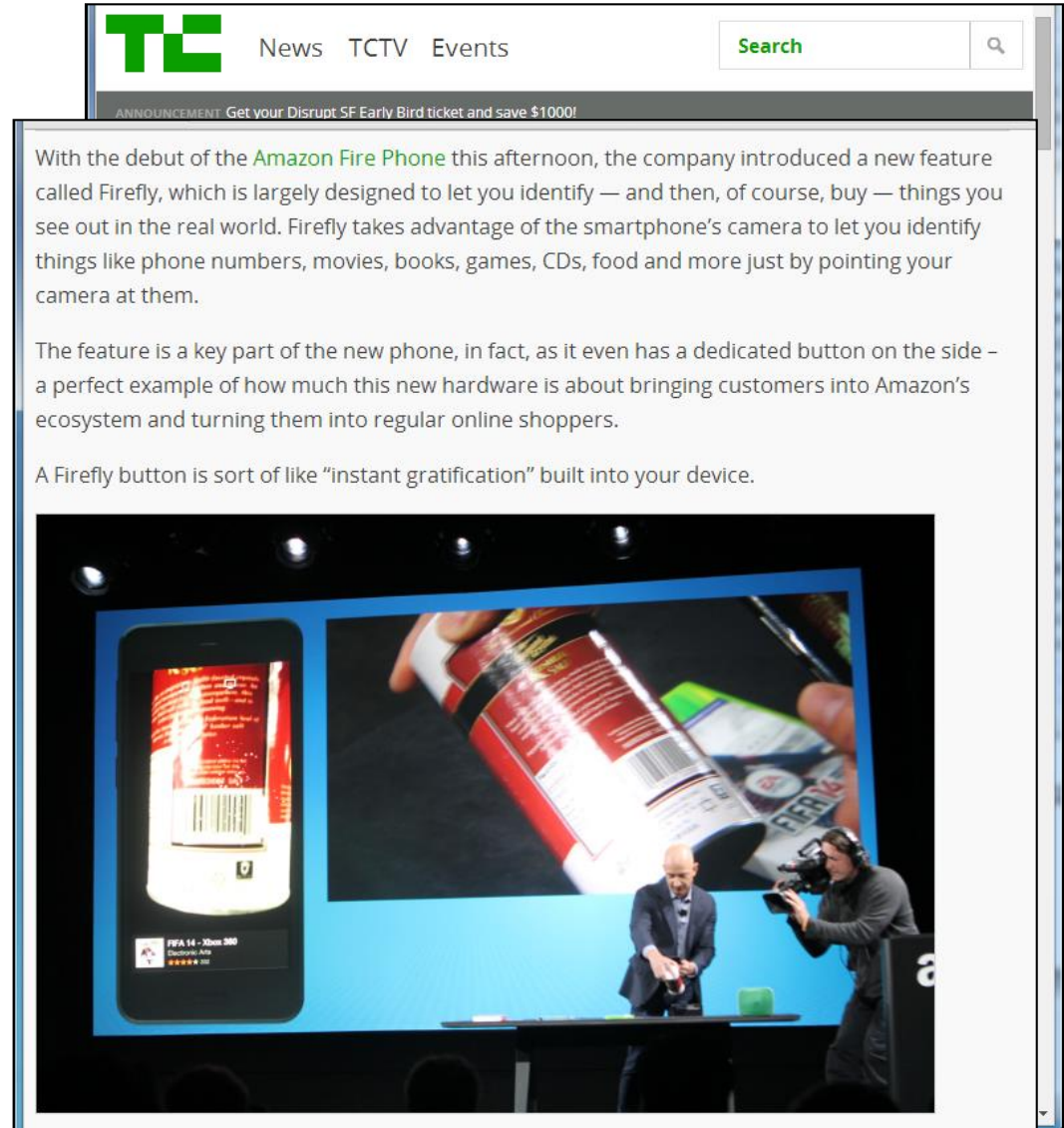
- LTU
- IQ Engines
- etc



- Match object in database on millions of objects in Amazon's EC2 Cloud Computing Services

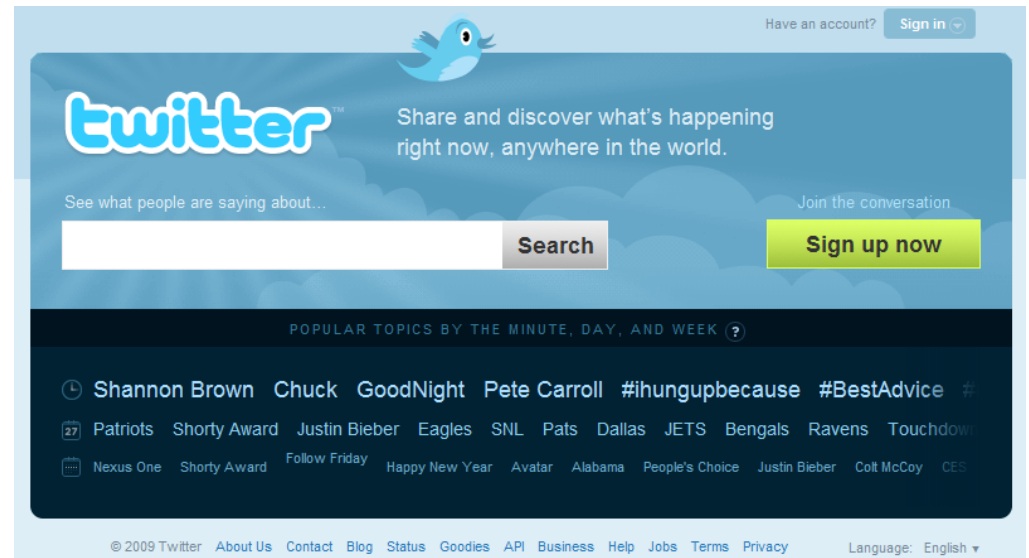
Amazon Firefly

- Specializes in logo recognition
- Perform recognition & matching in real-time
 - Match to logo, covers etc in Amazon database
 - Did very well in limited domain
 - Try download a mobile version to try



Social Network Sites

- How do you see the big picture involving FaceBook and Twitter?



- Facebook has been the most popular site, overtaking Google 3 years ago in terms of user traffic
- They are also the largest photo sharing sites, with more than 250 million uploads each month

Photo Sharing: on Instagram



- Fun app: give users capability to transform picture to professional looking ones
- Simple technology, innovative implementation & good timing
- Bought by Facebook for US\$1 Billion



Trends

- Leveraging on huge amount of images on social media
 - Example, 1/3 of Weibo have images, and 60% of these images do not have text annotation
- Fun and Utility social app based on photos
 - Such as Instagram, Path
- Increasingly requires content-based matching capability
- Real-time, social and Location!!!
- Business Models:
 - B2C or Consumer in the past
 - More recently towards enterprise (B2B model)

Recap: Aims and Objectives

- This module introduces students to the concepts, issues, design, implementation, standards and applications of multimedia technologies:
with special emphasis on media representation, standards, content analysis and search
- The module is divided into 2 parts:
 - 1) Fundamentals and Standards of Digital Media
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Next Lesson

- **Introduction to Concepts**