Patterns for Personalized Web Applications

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Abstract

In this paper we present some patterns we mined in Web applications that present some kind of personalized structure or behavior. We first introduce the growing need to include personalization features in Web applications and present a taxonomy for reasoning about design structures for personalization. Finally, we present 4 personalization patterns: Link Personalization, Content Personalization, Structure Personalization and Remote Personalization

Introduction and Context

Building personalized Web applications, i.e. those applications that are responsive to the individual needs of each user or group of users, is a challenging task. It involves a myriad of different technologies that range from simple database views to software agents and collaborative filtering algorithms. Personalization has become hype in areas such as electronic commerce, and we can find hundreds of applications that claim to be fully customizable to different user profiles or individuals. The number of possible personalization variants seems countless. As with other Web features, a great variety of technologies and systems have been developed and are available in the market [CACM00], but little or no attention has been paid to the process of modeling and designing personalized Web applications.

In the past five years we have been mining patterns for different aspects of Web applications such as their navigation topology [Rossi99a, Rossi99b], their interfaces [Rossi00a]. Some patterns are specific to particular application fields like e-commerce [Rossi00b] or to particular aspects like searching [Lyardet99]. In all cases, our Web patterns are more similar to Alexandrian [Alexander77] patterns than to [Gamma95] patterns as they are not described as collaboration among objects but as navigable design structures (as Alexander's urban structures).

The context in which we mined this patterns is the Object-Oriented Hypermedia Design Method (OOHDM) approach [Schwabe98] though they can be obviously used with other methods. In OOHDM a Web application is conceived as a hypermedia view on an object model. This view comprises nodes (the objects that the user will navigate), links that conform the navigation topology, navigation contexts that represent sets to be navigated sequentially and different kinds of indexes. As with object-oriented patterns, hypermedia (and Web) patterns go beyond the naive use of the basic theoretical concepts. These patterns indicate how to build usable hypermedia topologies by creating elaborated structures.

The purpose of this paper is to present some recurrent design structures we find while exploring and building personalized applications. Patterns for personalization can be analyzed from different perspectives. For example we can think about object-oriented patterns usually found in these kind of applications. By the way many [Gamma95] patterns are useful in this context; for example using Strategy we can assign different algorithms for finding recommendations to different users in an electronic store. Decorators can be used to assign different access privileges in a Web application, etc (See [Rossi01]. Personalization can be analyzed also from the point of view of how it is perceived by the user (i.e. how the personalized interface looks like) or how personalized features are generated (e.g. chosen by the user or automatically).

In this paper we chose to present some patterns that are based on what it is customized more than how it is done. They present a rather coarse granularity so they can eventually be refined in specific applications as it is shown. They show different kind of personalization that one may usually find in successful web applications.

Link Personalization

Intent:

Adapt the navigation topology to the user's needs or preferences

Motivation

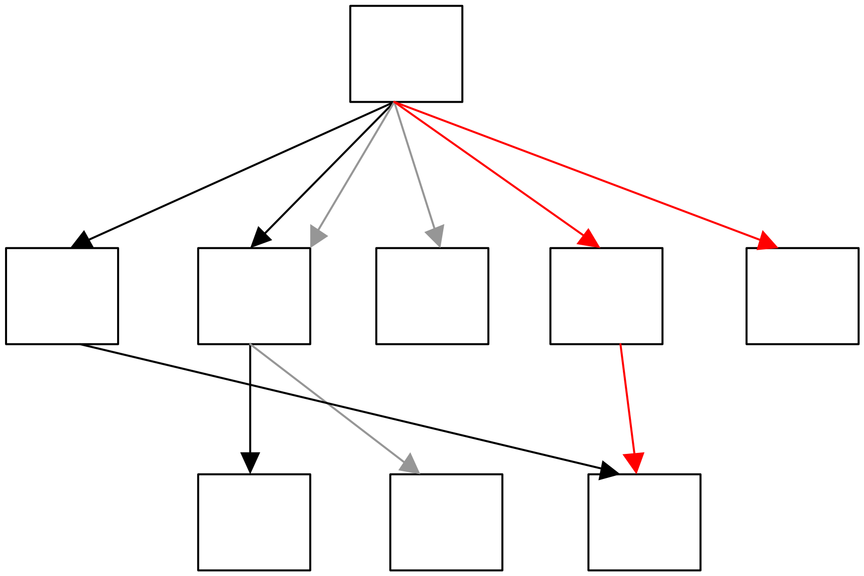
Web applications involve accessing thousands of objects. However the way in which users reach those objects may depend on many different factors. For example certain users may be allowed to access to some information while others could be disallowed. In certain e-commerce applications for example we may want to suggest some items to a customer according to his buying history. Though this product will be available to every user, each one of them will reach the product following different paths.

Forces

- Web applications deal with many objects and accessing them is not always straightforward
- Different users may have different access rights according to their role in the application. Letting them know that they can not access an object after they tried to navigate to it is not reasonable
- We may want to take into account the user's preferences to suggest them some items of their interest.

Solution

Define personalized links for connecting different nodes of the application as shown in Figure 1. In this way, though the information space does not change (i.e. we do not need to modify the objects, just the links) some nodes may be easier to access to some users than to others. We may even preclude the access to certain information to some individuals or groups of individuals by just providing the user with different sets of links. Link personalization may involve complex algorithms that define target nodes according to user preferences. For example in recommendation systems one may use collaborative filtering to find the nodes to be recommended. In other cases the target nodes may be just obtained by querying a database where they are explicitly organized (i.e. the data model itself contains the personalized aspects).

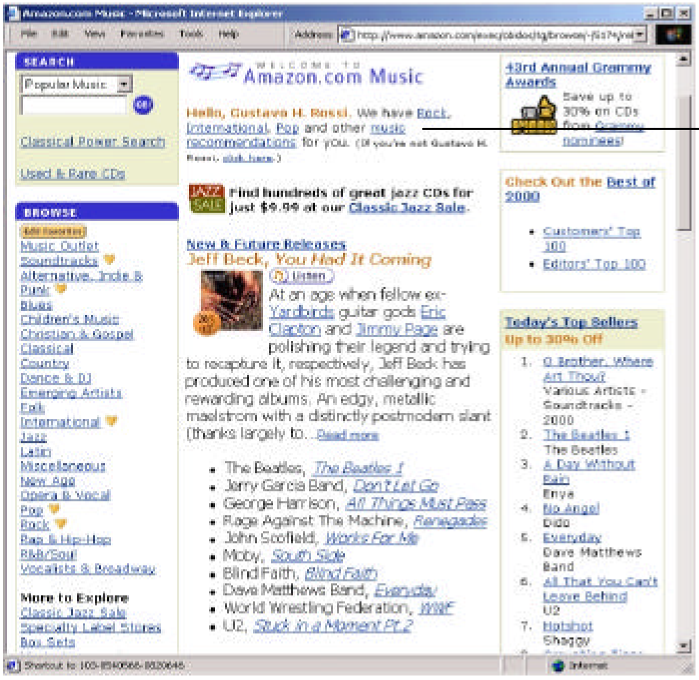


The color of links indicates the individual that can follow that link. For the sake of simplicity we did not include links that are perceived by every user

Figure 1: Different topologies for different users

Examples

The most widely known example of link personalization is in electronic stores as a way to give recommendations or to personalize new products in the store. In Figure 2 we show an example of Link personalization in Amazon.com. Another slightly different example can be found in conference papers reviewing systems. Each reviewer is provided with a set of links to the papers he will evaluate as shown in Figure 3. Notice that while in the first case, link personalization is used just to facilitate the access to certain products (with a clear commercial intent), in the second example the navigation space of each user is clearly different. They just navigate different objects.



Hello, Gustavo H. Rossi. We have Rock, International, Pop and other music recommendations for you. (If you're not Gustavo H. Rossi, click here.)

JAZZ SALE Find hundreds of great jazz CDs for just $9.99 at our Classic Jazz Sale.

New & Future Releases

Jeff Beck, You Had It Coming

At an age when fellow ex-Yardbirds guitar gods Eric Clapton and Jimmy Page are polishing their legend and trying to recapture it, respectively, Jeff Beck has produced one of his most challenging and rewarding albums. An edgy, metallic maelstrom with a distinctly postmodern slant (thanks largely to... Read more

- The Beatles, The Beatles 1
- Jerry Garcia Band, Don't Let Go
- George Harrison, All Things Must Pass
- Rage Against The Machine, Renegades
- John Scofield, Works For Me
- Moby, South Side
- Blind Faith, Blind Faith
- Dave Matthews Band, Everyday
- World Wrestling Federation, WWF
- U2, Stuck in a Moment Pt.2

43rd Annual Grammy Awards

Save up to 30% on CDs from Grammy nominees!

Check Out the Best of 2000

- Customers' Top 100
- Editors' Top 100

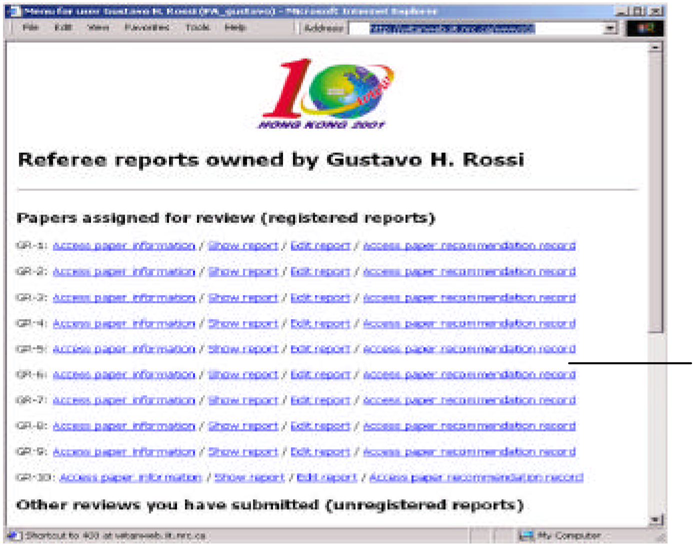
Today's Top Sellers

Up to 30% Off

1. O Brother, Where Art Thou? Various Artists - Soundtracks - 2000
2. The Beatles 1 The Beatles
3. A Day Without Rain Enya
4. No Angel Dido
5. Everyday Dave Matthews Band
6. All That You Can't Leave Behind U2
7. Hotshot Shaggy

Different users will have links to different items

Figure 2: Link Personalization in Amazon.Com



Menu for user Gustavo H. Rossi (PA_gustavo) - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Address
HONG KONG 2001
Shortcut to 433 at vabanweb.iit.nrc.ca
My Computer

Referee reports owned by Gustavo H. Rossi

Papers assigned for review (registered reports)

GR-1: Access paper information / Show report / Edit report / Access paper recommendation record

GR-2: Access paper information / Show report / Edit report / Access paper recommendation record

GR-3: Access paper information / Show report / Edit report / Access paper recommendation record

GR-4: Access paper information / Show report / Edit report / Access paper recommendation record

GR-5: Access paper information / Show report / Edit report / Access paper recommendation record

GR-6: Access paper information / Show report / Edit report / Access paper recommendation record

GR-7: Access paper information / Show report / Edit report / Access paper recommendation record

GR-8: Access paper information / Show report / Edit report / Access paper recommendation record

GR-9: Access paper information / Show report / Edit report / Access paper recommendation record

GR-10: Access paper information / Show report / Edit report / Access paper recommendation record

Other reviews you have submitted (unregistered reports)

Different reviewers will get different links (pointing to different papers and recommendation records)

Figure 3: Link Personalization in Conference Reviewing Systems

Consequences

- Provides customizable navigation spaces according to users' preferences or profiles
- Gives an elegant way to implement access rights to specific nodes
- May eventually complicate the underlying data model or require specific algorithms to get links' target objects

Related Patterns

Advising [Rossi00b] uses Link personalization when dealing with recommendations. However we can provide non-personalized advice (for example towards some new products) and we can use Link personalization in other situations different than advising. Link personalization may be thought as a particular case of Content personalization and it is also used to achieve Structure personalization (see next patterns).

Content Personalization

Intent

Provide the user with personalized contents in nodes

Motivation

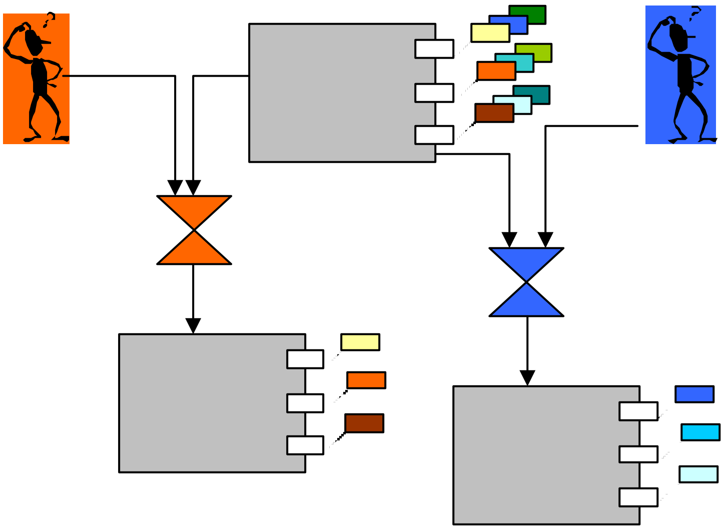
In many Web applications we may want to provide users with slightly different content about particular information items. For example, we may want that different buyers in a virtual store pay different prices according to their buying history or show the price in his preferred currency. Notice that while Link Personalization may help us to build personalized navigation topologies it is still the case that we may need a finer grained information customization. We could eventually solve this problem by personalizing links but we would split an object into smaller objects containing the personalized attributes what is obviously not convenient. In the context of an object-oriented modeling approach (like OOHDM) we need that an object that will be perceived by users exhibit different values in its attributes when accessed by different individuals.

Forces

- Web applications deal with thousands of objects which may themselves have many attributes
- We may want to show different values of the same attribute (e.g. the price of a CD) to different users
- Adding new navigation objects may yield an unnatural network of nodes (e.g. personalizing the link to different price objects)

Solution

Define personalized contents in nodes by letting the attributes of nodes vary according to the user. This means that the value of an attribute should be treated as a function of the user as shown in Figure 4. From an object-oriented point of view this means partially decoupling the value of the attribute from its objects and coupling it with the user.

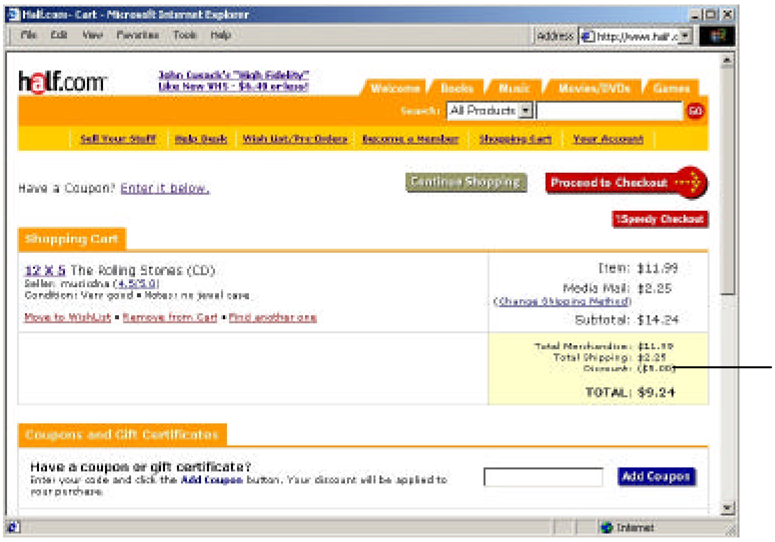


Small colored boxes indicate possible attribute values. Depending on each user, the appropriate attribute values are selected. The colored triangles indicate the customization filters that are applied in each case

Figure 4: Personalizing the contents of a node

Examples

Individual pricing in e-commerce applications is the most widely known example of content personalization. For example in www.half.com users can apply their discount certificates to obtain better price for an item as shown in Figure 5.



Have a Coupon? Enter it below.

12 X 5 The Rolling Stones (CD)
Seller: muriodna (4.5/5.0)
Condition: Very good • Notes: no jewel case

Move to WishList • Remove from Cart • Find another one

Item: $11.99
Media Mail: $2.25
(Change Shipping Method)
Subtotal: $14.24

Total Merchandise: $11.99
Total Shipping: $2.25
Discount: ($5.00)

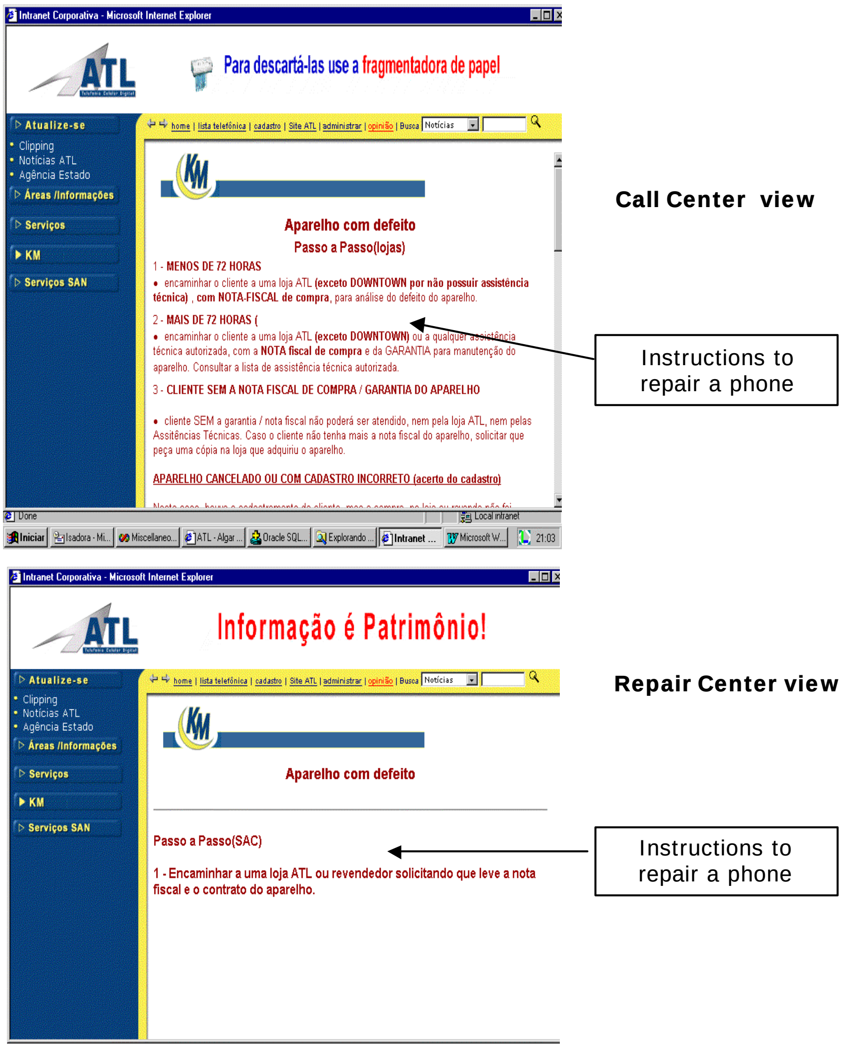
TOTAL: $9.24

Have a coupon or gift certificate?
Enter your code and click the Add Coupon button. Your discount will be applied to your purchase.

Notice that the value of the attribute Discount is personalized according to the user's buying history

Figure 5: Content personalization in www.half.com

Another interesting example can be found in some intranet applications where different users of the intranet read different text for the same item. For example in the ATL (a mobile phone company in Rio the Janeiro) intranet, different sales channels receive different, customized information about business procedures. When a call center attendant looks up information about phone repairs he will receive the address of a repair center; when a repair center employee looks up information for the same procedure, he will receive repair instructions for the phone, as shown in Figure 6.



Aparelho com defeito

Passo a Passo(lojas)

1 - MENOS DE 72 HORAS

- encaminhar o cliente a uma loja ATL **(exceto DOWNTOWN por não possuir assistência técnica) , com NOTA-FISCAL de compra**, para análise do defeito do aparelho.

2 - MAIS DE 72 HORAS (

- encaminhar o cliente a uma loja ATL **(exceto DOWNTOWN)** ou a qualquer assistência técnica autorizada, com a **NOTA fiscal de compra** e da GARANTIA para manutenção do aparelho. Consultar a lista de assistência técnica autorizada.

3 - CLIENTE SEM A NOTA FISCAL DE COMPRA / GARANTIA DO APARELHO

- cliente SEM a garantia / nota fiscal não poderá ser atendido, nem pela loja ATL, nem pelas Assitências Técnicas. Caso o cliente não tenha mais a nota fiscal do aparelho, solicitar que peça uma cópia na loja que adquiriu o aparelho.

APARELHO CANCELADO OU COM CADASTRO INCORRETO (acerto do cadastro)

Intranet Corporativa - Microsoft Internet Explorer
ATL
Informação é Patrimônio!
Atualize-se
Clipping
Notícias ATL
Agência Estado
Áreas /Informações
Serviços
KM
Serviços SAN
home | lista telefônica | cadastro | Site ATL | administrar | opinião | Busca
Notícias
Repair Center view
Instructions to repair a phone

Aparelho com defeito

Passo a Passo(SAC)

1 - Encaminhar a uma loja ATL ou revendedor solicitando que leve a nota fiscal e o contrato do aparelho.

Figure 6: Content Personalization in the ATL Intranet

Consequences

- We improve personalization as the same object may look different when accessed by different persons.
- The navigation topology is not affected at all thus simplifying design and implementation

Related Patterns

Content Personalization has some intersections with Link Personalization and with Structure Personalization (see this pattern below). Each time we personalize a link we are in fact personalizing some aspect of the node's content (its anchors). However we see these patterns as different, because their intent is not the same.

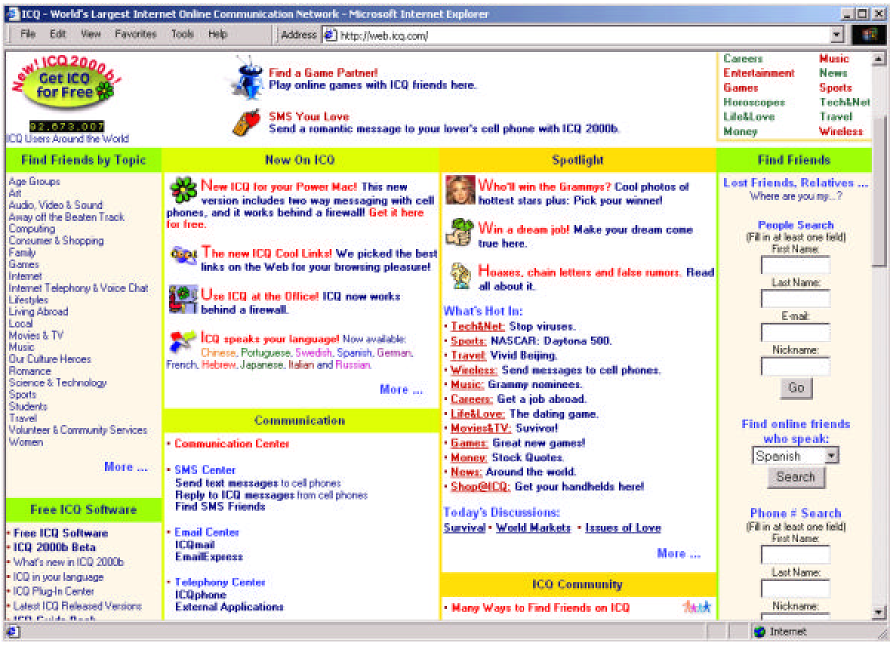
Structure Personalization

Intent

Bound the navigation space to the aspects the user is interested in.

Motivation

Some kind of Web applications (such as information portals) not only involve dealing with a great number of objects but mainly with a great variety of subjects and services. When you face Web sites like netscape.com, cnn.com or even icq.com you may find yourself overwhelmed not only by the number of possible links to follow but for the diversity of subjects and possibilities (See Figure 7).



Find a Game Partner!
Play online games with ICQ friends here.

SMS Your Love
Send a romantic message to your lover's cell phone with ICQ 2000b.

Find Friends by Topic

Age Groups
Art
Audio, Video & Sound
Away off the Beaten Track
Computing
Consumer & Shopping
Family
Games
Internet
Internet Telephony & Voice Chat
Lifestyles
Living Abroad
Local
Movies & TV
Music
Our Culture Heroes
Romance
Science & Technology
Sports
Students
Travel
Volunteer & Community Services
Women

More ...

Free ICQ Software

- Free ICQ Software
- ICQ 2000b Beta
- What's new in ICQ 2000b
- ICQ in your language
- ICQ Plug-In Center
- Latest ICQ Released Versions

New On ICQ

New ICQ for your Power Mac! This new version includes two way messaging with cell phones, and it works behind a firewall! Get it here for free.

The new ICQ Cool Links! We picked the best links on the Web for your browsing pleasure!

Use ICQ at the Office! ICQ now works behind a firewall.

ICQ speaks your language! Now available: Chinese, Portuguese, Swedish, Spanish, German, French, Hebrew, Japanese, Italian and Russian.

More ...

Communication

- Communication Center
- SMS Center
  Send text messages to cell phones
  Reply to ICQ messages from cell phones
  Find SMS Friends
- Email Center
  ICQmail
  EmailExpress
- Telephony Center
  ICQphone
  External Applications

Spotlight

Who'll win the Grammys? Cool photos of hottest stars plus: Pick your winner!

Win a dream job! Make your dream come true here.

Hoaxes, chain letters and false rumors. Read all about it.

What's Hot In:

- Tech&Net: Stop viruses.
- Sports: NASCAR: Daytona 500.
- Travel: Vivid Beijing.
- Wireless: Send messages to cell phones.
- Music: Grammy nominees.
- Careers: Get a job abroad.
- Life&Love: The dating game.
- Movies&TV: Suvivor!
- Games: Great new games!
- Money: Stock Quotes.
- News: Around the world.
- Shop@ICQ: Get your handhelds here!

Today's Discussions:
Survival • World Markets • Issues of Love

More ...

ICQ Community

- Many Ways to Find Friends on ICQ

Find Friends

Lost Friends, Relatives ...
Where are you my...?

People Search
(Fill in at least one field)
First Name:
Last Name:
E-mail:
Nickname:

Find online friends who speak:
Spanish

Phone # Search
(Fill in at least one field)
First Name:
Last Name:
Nickname:

Figure 7: Cognitive overhead in a complex information structure

One solution to this problem is to organize those subjects in a taxonomic way but the result may be that the user will be reluctant to navigate to lower level objects thus loosing the opportunity to reach those objects. The problem here is how to find good structures for information portals that give the user some freedom of navigation but without causing a cognitive overhead because of the number of possible choices. The solution is to personalize the structure of the site.

Forces

- There are Web applications that involve dozens of different information concerns or services
- Users can not manage to find what they want to see when the information space is too dense. Even when they found the information once, they will like to find it in an easier way.
- Different users may be interested in different subjects; some particular users may not be interested at all on a particular subject or service

Solution

Personalize (or let the user do it) the structure of the Web site. Consider it as providing access to a (potentially) big set of modules, each one of which may be itself composed of other ones and eventually links to concrete information objects. Select only the modules in which the user is interested in and from this modules only show the information that the user may like or prefer to read, thus simplifying the appearance of web pages. In Figure 8 we show a schema of what structure personalization implies.

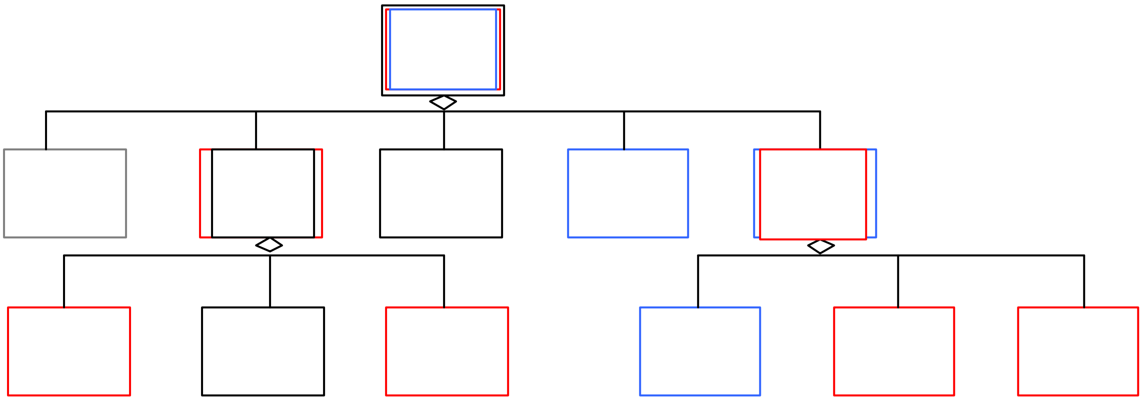
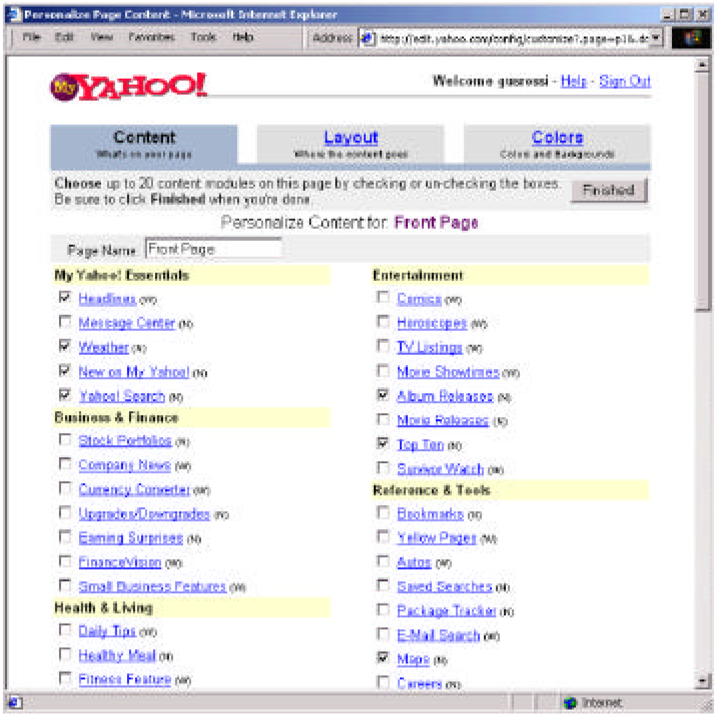


Figure 8: Structure Personalization

In Figure 7 we show a Web page as an aggregation of different modules (See Figure 8 for a concrete example). Each color indicates a particular user. Notice that different users perceive a different modules structure for their own pages.

Examples

The most widely known examples of structure personalization can be found in my.xx.com sites like www.my.yahoo.com or www.mycnn.com , in which the user personalizes his page according to his interests. For example in my.yahoo.com one can select a set of modules (from a large number including weather, news, technological news, Financial Portfolios, Travel, Health, etc). Each module can be further customized; for instances we can choose the temperature of which cities in the world we can see or the musical genre from which we want to have news as shown in Figure 9 and 10.



Personalize Page Content - Microsoft Internet Explorer

Address: http://edit.yahoo.com/config/customize?.page=p1&.dc

Welcome guerossi - Help - Sign Out

Content — What's on your page | Layout — Where the content goes | Colors — Colors and Backgrounds

Choose up to 20 content modules on this page by checking or un-checking the boxes. Be sure to click **Finished** when you're done. [Finished]

Personalize Content for **Front Page**

Page Name: Front Page

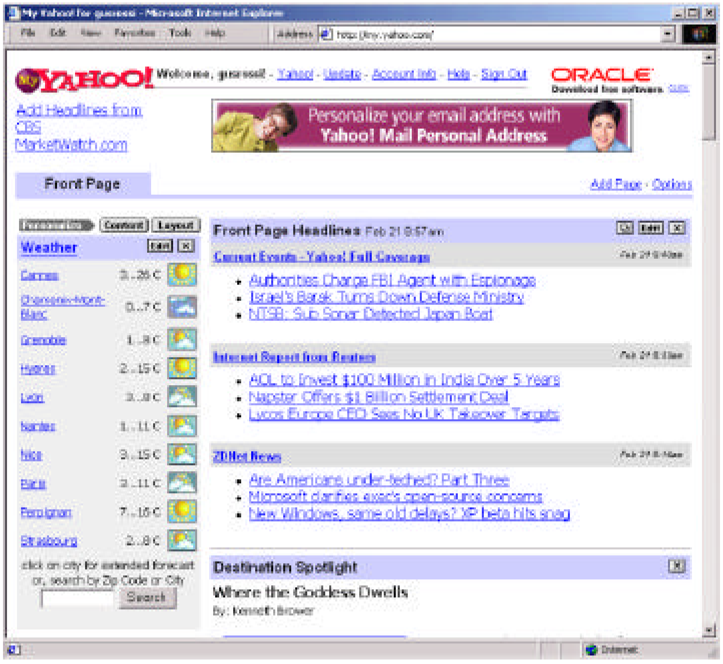
My Yahoo! Essentials
- ☑ Headlines
- □ Message Center
- ☑ Weather
- ☑ New on My Yahoo!
- ☑ Yahoo! Search

Business & Finance
- □ Stock Portfolios
- □ Company News
- □ Currency Converter
- □ Upgrades/Downgrades
- □ Earning Surprises
- □ FinanceVision
- □ Small Business Features

Health & Living
- □ Daily Tips
- □ Healthy Meal
- □ Fitness Feature

Entertainment
- □ Comics
- □ Horoscopes
- □ TV Listings
- □ Movie Showtimes
- ☑ Album Releases
- □ Movie Releases
- ☑ Top Ten
- □ Survivor Watch

Reference & Tools
- □ Bookmarks
- □ Yellow Pages
- □ Autos
- □ Saved Searches
- □ Package Tracker
- □ E-Mail Search
- ☑ Maps
- □ Careers



My Yahoo! for guerossi - Microsoft Internet Explorer

Address: http://my.yahoo.com/

Welcome, guerossi! - Yahoo! - Update - Account Info - Help - Sign Out

Add Headlines from CBS MarketWatch.com

ORACLE
Download free software
Personalize your email address with
Yahoo! Mail Personal Address

Front Page — Add Page - Options

Weather

Cannes	3..26 C
Chamonix-Mont-Blanc	0..7 C
Grenoble	1..8 C
Hyeres	2..15 C
Lyon	3..8 C
Nantes	1..11 C
Nice	3..15 C
Paris	3..11 C
Perpignan	7..16 C
Strasbourg	2..8 C

click on city for extended forecast or, search by Zip Code or City [Search]

Front Page Headlines Feb 21 8:57am

Current Events - Yahoo! Full Coverage
- Authorities Charge FBI Agent with Espionage
- Israel's Barak Turns Down Defense Ministry
- NTSB: Sub Sonar Detected Japan Boat

Internet Report from Reuters
- AOL to Invest $100 Million in India Over 5 Years
- Napster Offers $1 Billion Settlement Deal
- Lycos Europe CEO Sees No UK Takeover Targets

ZDNet News
- Are Americans under-teched? Part Three
- Microsoft clarifies exec's open-source concerns
- New Windows, same old delays? XP beta hits snag

Destination Spotlight

Where the Goddess Dwells

By: Kenneth Brower

Figure 9: Structure Personalization in my.yahoo.com

Consequences

- The overall navigation space is reduced taking into account the users' interests.
- Customization is usually performed by the user manually which may be a burden for him**.**
- It may be necessary to provide an interface for letting the user personalize the structure

Related Patterns

Structure personalization is strongly related with link personalization. In almost every example of structure personalization we can find some customization of the links topology. However, personalizing structure involves a higher level view of the site's structure by viewing it as a set of modules from which the user selects what he wants.

Client-side Personalization

Intent

Allow a Web application to provide different customized information when accessed from different client sites

Motivation

Suppose you are building a Web application that is conceived to be accessed from different contexts (as an added service to other applications). For example some news portals like CNN.com allows you to have views on the information from you site. Amazon.com also lets you have a link to its page with a specialized search query (for example after a yahoo search you can directly link to amazon to search a book with those keywords).
The problem arises if you want that this service can be customized from the client application in such a way that when accessing your applications from different places, it can show, for, example, different information.

Forces

- Some Web applications are supposed to provide public (or semi public) services to other applications, such as providing information search facilities, etc
- In these kind of applications it may be necessary to provide different "views" of the same service
- We may even want to give different services according to the client "profile"

Solution

Let the client application personalize what will be seen from the service provider and how it fits into the client site. Notice that Remote Personalization is implemented in the provider side by allowing clients to personalize services. There are basically two kind of remote personalization strategies. One is to let the client application show some "window" of the service provider information. The other one is to customize what will be seen in the service provider side when navigating to it from one of the client sites.
In Figure 10 we show a schema of what remote personalization means.

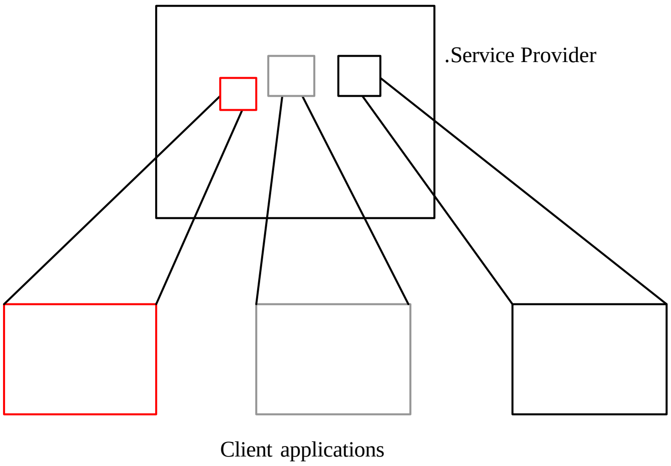
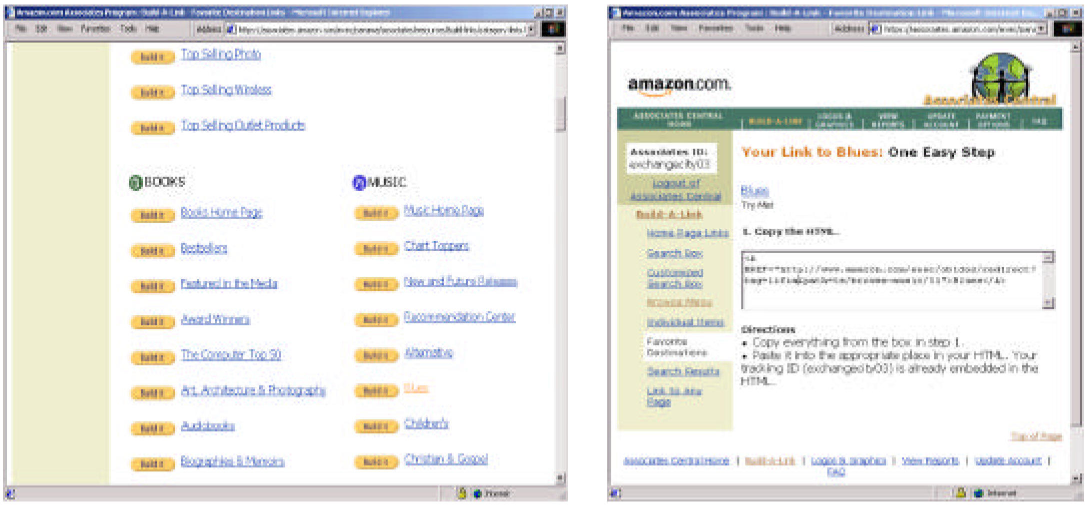


Figure 10: Remote Personalization Schema

In Figure 10 different client web applications can personalize their “window” into the information sea provided by the service provider.

Examples

There are many interesting examples of this kind of customization. For example amazon.com let “associates” sites to personalize what a user will see in Amazon while navigating from the other site. In Figure 11 we show part of the process of personalization; in Figure 12 meanwhile we show what we seen in Amazon when entering from the personalized client.



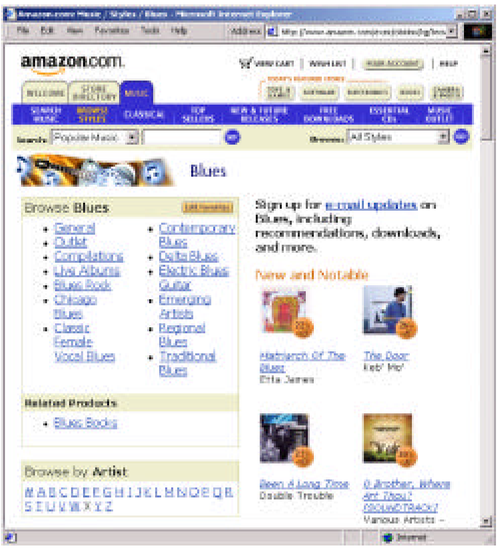
Your Link to Blues: One Easy Step

Blues
Try Me!

1. Copy the HTML.

Directions
- Copy everything from the box in step 1.
- Paste it into the appropriate place in your HTML. Your tracking ID (exchangecity03) is already embedded in the HTML.

Figure 11: Personalizing the access to Amazon.com



Blues

Browse **Blues**

- General
- Outlet
- Compilations
- Live Albums
- Blues Rock
- Chicago Blues
- Classic Female Vocal Blues
- Contemporary Blues
- Delta Blues
- Electric Blues Guitar
- Emerging Artists
- Regional Blues
- Traditional Blues

Related Products

- Blues Books

Browse by **Artist**

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Sign up for e-mail updates on Blues, including recommendations, downloads, and more.

New and Notable

Matriarch Of The Blues
Etta James

The Door
Keb' Mo'

Been A Long Time
Double Trouble

O Brother, Where Art Thou? (SOUNDTRACK)
Various Artists

Figure 12: The “client-side” personalized Amazon

In octopus.com you can personalize the “information window” you have to other sites as shown in Figure 13. Notice that this example of client-side personalization is rather similar to the personalization of links. However from the server side (in this case CNN.com) the case is completely different: again you are personalizing what you see from clients.

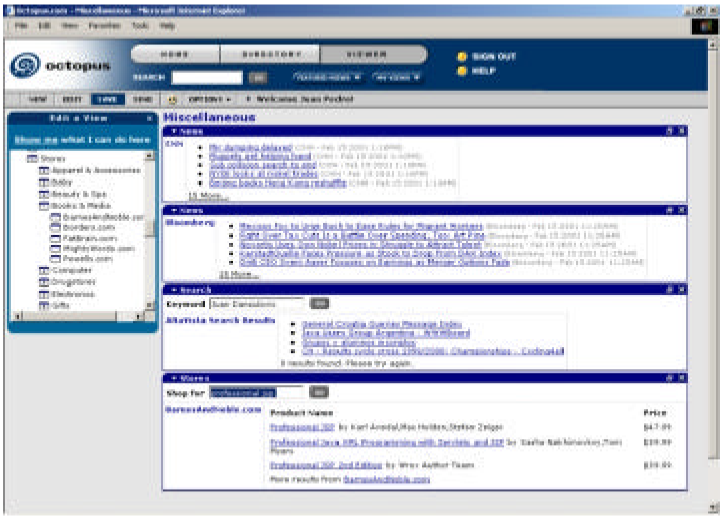


Figure 13: Client-side customization in Octopus.com

Consequences

- You can provide an additional service to other sites by allowing them to choose what they will use from yours
- Personalization is usually manual, what may be a burden
- You must provide an interface for clients to personalize their views

Related Patterns

When viewed from the client sites, this pattern may be similar to structure and link personalization. In Figure 13 for example Octopus.com is a good example of Structure Customization. However from the server side (CNN, Bloomberg, etc) this pattern reflects the decoupling one may find in the Observer design pattern, where the base information of the server represents the subject and each client (including the "default" view) represent an observer.

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