

Personalized hypermedia presentation techniques for improving online customer relationships

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INF 231 – Human-Computer Interaction

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Outline

- I. Introduction
- II. Input data and acquisition methods
 - a. User data
 - b. Usage data
 - c. Environment data
- III. Representation and secondary inferences
- IV. Adaptation production
- V. Conclusions and prospects

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I. Introduction

- E-commerce
- Customer Relationship Software
- Hypermedia Personalisation techniques

E-commerce

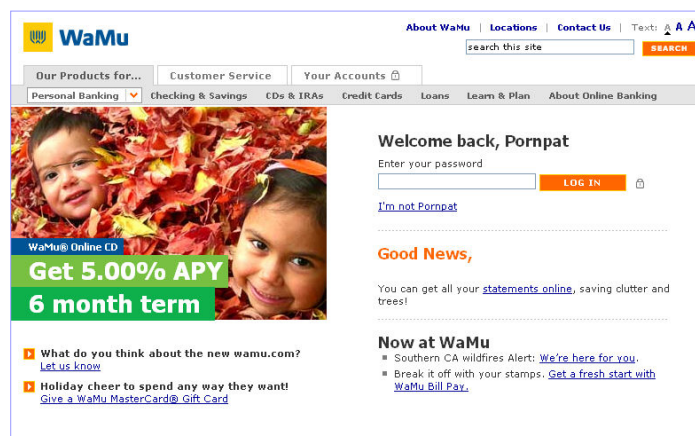
Scenario in today's competitive business environment.

- **Pre-sales phase**
 - Corporate Identity, draw attention to products & services
- **Sales phase**
 - Online storefronts, ordering/purchasing facilities
- **Post-sales phase**
 - Reassurance, product support, loyalty program

Customer Relationship Software

- Facilitates collection of information about large number of customers (interests, purchase behavior, support needs)
- Dynamic nature - updates of contents & presentation to react to new opportunities & challenges
- Global around-the-clock presence independent of its locality
- Dynamic creation of content & presentation for personalised information delivery.

Popular e-commerce website offer personalisation



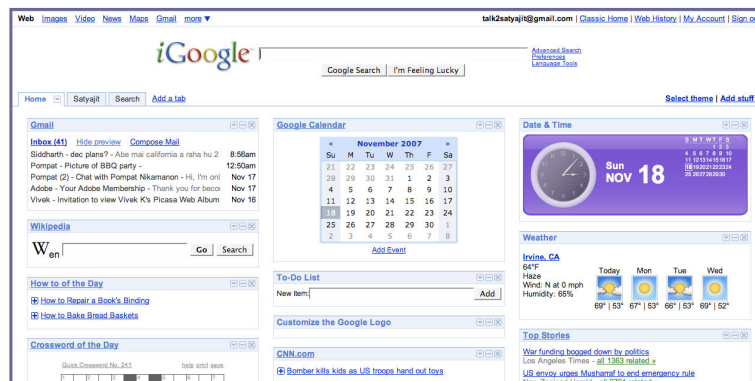
Popular e-commerce website offer personalisation



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Popular e-commerce website offer personalisation



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Popular e-commerce website offer personalisation



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Personalised Hypermedia Application

A system which adapts the content, structure and/or presentation of the networked hypermedia objects to each individual **users characteristics**, **usage behavior** and **usage environment**.

There are different basic types of adaptation depending upon the amount of control user has over the adaptation.

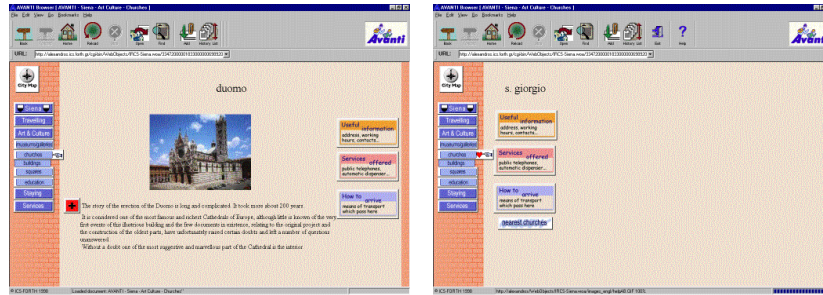
- **Adaptive system**- system performs all steps autonomously.
- **User controlled adaptivity** - the system lets the user make selection and performs the adaptation.
- **User initiated adaptivity** - user request and lets the system decide the best option.

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Personalised Hypermedia Application

Adaptive system



AVANTI - Tourist information system

- This is a result of **Adaptivity**, which means that the system recognizes that the user is interested in churches, thus it highlights the corresponding options.

II. Input data and acquisition methods

Different types of the data and methods of acquiring the information about the user's characteristics, computer usage behavior and usage environment which are required in adapting the system to the user's needs

- User data
- Usage data
- Environment data

Input data and acquisition methods

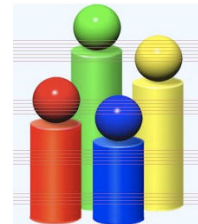
User data

- Personal characteristics of the user.
 - Demographic data
 - User knowledge
 - User skills and capability
 - User interests and preferences
 - User goals and plans

User data

Demographic data

Types	Examples
Record data	Name, address, phone number
Geographic data	Area code, city, state, country
User characteristics	Age, sex, education, disposable income
Psychographic data	Data indicating lifestyle
Customer qualifying data	Frequency of product/service usage
Other Registration Data	Information offerings, participation in raffles



User data

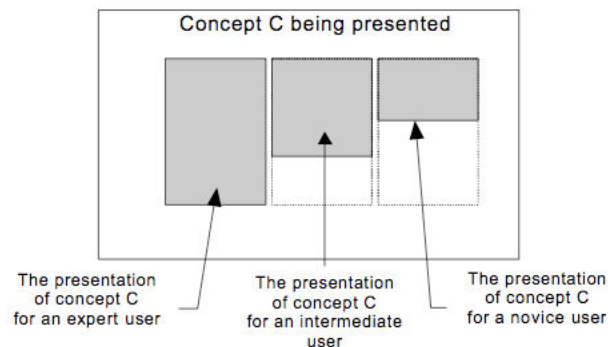
User Knowledge data

Assumptions about users' knowledge about concepts, relationships between concepts and facts and rules with regard to the domain of the application system are the most important sources for personalisation.

Examples:-

- Restricting or increasing the explanatory pages to be presented to the user depending on his or her expertise.
- Generating expertise dependent product description.
- Intelligent tutoring systems.

Conditional text Presentation



Conditional text Presentation

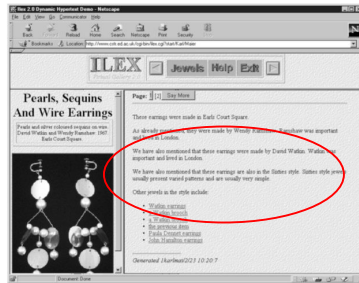


Figure 9 Text presentation to a visitor with no specific interests from ILEX, 1999; reprinted with permission)

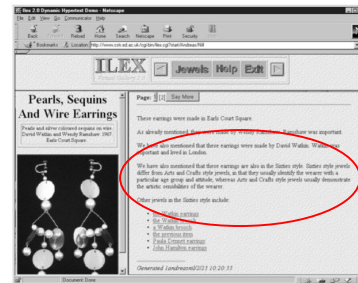


Figure 8 Text presentation to a user with an interest in styles (from ILEX, 1999; reprinted with permission)

ILEX - adaptive learning system

Generates interest-tailored descriptions of objects which are tuned to different user interests.

User data

User Skills and capabilities

- Knowledge of the ability and skills of the users plays an important role in adapting systems to users needs.
- The system may also distinguish between the actions a user is familiar with and the actions he or she is actually able to perform. It is possible that a user knows how to do something but is not able to perform the action due to lack of required permissions or to some physical handicap.
- Example:-
 - Adaptive help systems

User data



Tourist information system AVANTI takes the needs of different kinds of disabled people (wheelchair-bound, motor-impaired & vision-impaired) into account, therefore only recommends actions that these users are actually able to perform.

User data

User interests and preferences

- Interests among users of the same application often vary considerably.

Example:-

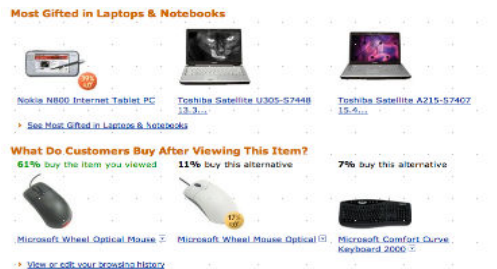
Promotion of cars to different audiences, conflicting sets of attributes (speed, sex-appeal, safety, family- friendliness) must be emphasised



User data

User interests and preferences

- User interest is a central notion for the Recommendation systems.
- The items recommended may be products, services, documents, news and so on.



User data

User interests and preferences

- Recommendations can also be made by asking users to rate items with which they are already familiar.



User data

User goals and plans

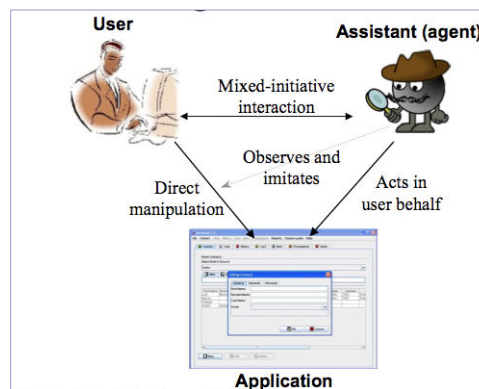
- Typical goals may be to find information on a certain topic or to shop for some kind of product.
- A system that supports users in achieving their goals facilitates and speeds up interaction considerably since the system has expectations about the next user actions and can therefore interpret them in a more flexible way.



User data

User goals and plans

Plan-Recognition



- Aims at identifying the goal (or intention) of the user based on the actions they perform in an environment
- Narrows the number of possible goals by observing the actions the user performs.

User data

User goals and plans

Plan Recognition - Inputs and outputs

■ Inputs:

- a set of goals the user carries out in the domain,
- a set of plans describing the way in which the user can reach each goal,
- an user-action observed by the system.

■ Output:

- foretelling the user's goal, and determining how the observed action contributes to reach it

User model acquisition methods

User supplied information

■ Active acquisition

User data is acquired through questions asked by the system, typically in an initial phase of system usage.

Caution: -

Self-assessment is error-prone since users are often not correctly aware of things like their own capabilities.

Some systems therefore present controlled queries, tests, exercises that are aimed at a more objective assessment of the user.



User model acquisition methods

User supplied information

Downside of active acquisition - Paradox of the Active User

Users are motivated to get started and are in a hurry to get their immediate task done. In cases of competing information sources, users may simply refuse to visit the site if they have to respond to an interview first. The paradox is information acquired will be helpful in adapting the system and making it more user-friendly in the long run.

The acquisition phase should therefore be minimised and ideally be administered only after the user has already obtained some impression about the benefits the site has to offer.

User model acquisition methods

Stereotype reasoning

A simple method for making a first assessment of others is to classify them into categories and to then make predictions about them based on a stereotype that is associated with each category.

Main components of stereotype are:-

- a body, which contains information that is typically true of users to whom the stereotype applies
- a set of activation conditions (“triggers”) for applying the stereotype to a user.

Types	Activation Condition	Stereotype
User data	user model shows that the user is interested in childcare	'Parent'
Usage Data	user bought two books of childcare	'Parent'
Usage Environment	if the user's browser is a recent beta version	'Computer wizard'

Usage data

- Observable usage
 - Selective actions
 - Temporal viewing behavior
 - Ratings
 - Purchases and purchase-related actions
 - Other confirmatory and disconfirmatory actions
- Usage regularities

Usage data - Observable usage

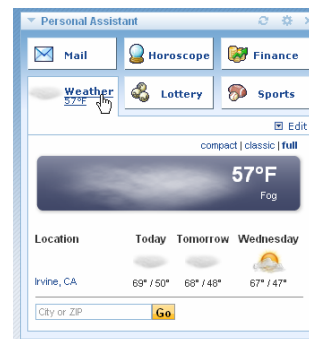
Selective actions

User makes a choice if competitive links are available on the current page

- Actions
 - Clicking link
 - Scrolling and enlarging operation
 - Document expansion operation
 - Movie and audio operation
 - Other actions at user interfaces
- Indicators
 - Interest
 - Unfamiliarity
 - Preferences



iGoogle



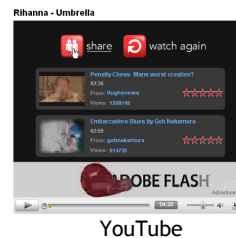
MY YAHOO!

Usage data - Observable usage

Temporal viewing behavior

Viewing time

- Difficulty of measurement
 - User not present in front of the computer
 - Window is covered by other windows
 - Item is outside the visible window area
- Negative evidence - not interesting to user
 - Presentation time less than certain threshold
 - Abort download
 - Presses the back button shortly after the page download commenced
- Streamed data (video/audio)
 - User reaction shortly after termination
 - User interest in this streaming
- Further research
 - Micro interaction level
 - Usage of eye-tracking



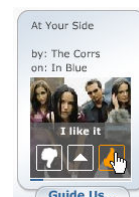
YouTube

Usage data - Observable usage

Ratings

Users are required to explicitly rate objects

- How relevant/interesting to user
- How relevant/interesting to other user
- Rating type
 - Binary scale (I don't like it / I like it)
 - Numeric scale (I hate it / I don't like it / It's OK / I like it / I love it)
- Problem
 - Relevance is always relative (changing)
 - User not rate



Pandora



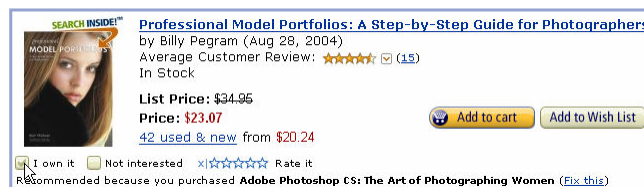
Amazon

Usage data - Observable usage

Purchases and purchase-related actions

A purchase is a strong indicator of user interest in some of the features of the purchased product

- React adaptively by suggesting similar or related items
- No one-to-one mapping between purchases and interests
 - Purchase for other people (gift)
 - Already own on available item



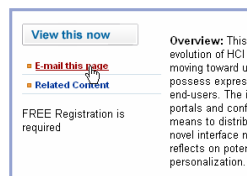
Amazon

Usage data - Observable usage

Other confirmatory and disconfirmatory actions

Strengthen an assumption in concert with a preceding selection

- Examples
 - Saving
 - Printing
 - Bookmarking
 - Forwarding by email



ZDNet



Amazon

Usage data - Usage regularities

Further processing of usage data to acquire information about users' preferences, habits, and levels of expertise

- User frequency
 - Categorize events and count their frequencies
 - Examples
 - Microsoft word - Adaptive icon toolbar
 - AVANTI - Introduce shortcut links
- Situation-action correlations
 - Interface agents / personal assistants
 - Suggestions based on statistics correlations between previous situations and action
- Action sequences
 - Recommend the generation of macros
 - Predict future user actions
 - Recommend actions



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Environment data

- Constraints
 - Software environment
 - Hardware environment
 - Locale
- Mapping model
 - Single-user machine
 - Multi-user machine



Environment data

- Software environment
 - Browser version and platform
 - Availability of plug-ins
 - Java and JavaScript
- Header of HTTP requests



User-Agent: Mozilla/4.0 (compatible; MSIE 6.0; Windows NT 5.1; SV1)

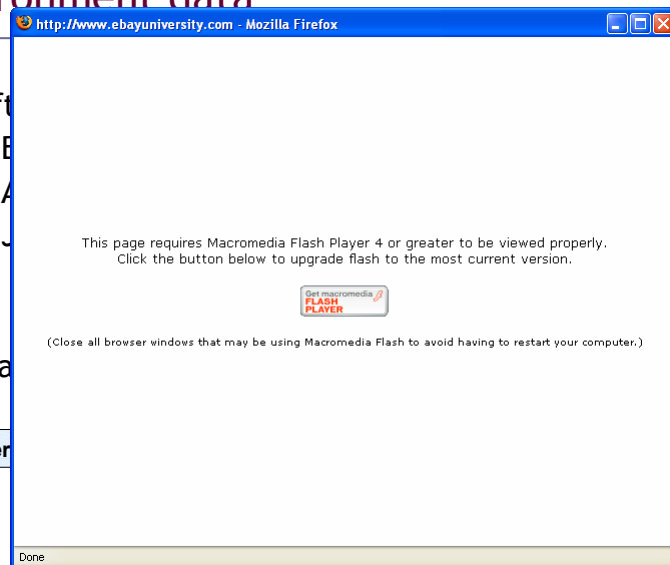
Environment data

■ Soft

- B
- A
- J

■ Hea

User



Environment data

■ Hardware environment

- Bandwidth
- Processing speed
- Display devices
- Input devices



Environment data

■ Locale

- Users' current location
- Characteristics of usage locale
 - noise level, brightness of the surrounding, etc.



III. Representation and secondary inferences

Most common representation approaches and the inference techniques

- **Deductive reasoning** - from the more general to the more specific
 - Logic-based representation and inference
 - Representation and reasoning with uncertainty
- **Inductive reasoning** - from specific cases to the general case
 - Learning about the user
- **Analogical reasoning** - from similar cases to the present case
 - Clique-based filtering
 - Clustering user profiles
- **A hybrid approach:** user profiles as learning results

IV. Adaptation production

Adaptation Production explains the possible types of adaptation to the user, usage and environment data of an individual user.

Adaptations in hypermedia systems can take place at different levels that we will discuss in the following sections:

- Adaptation of content
- Adaptation of presentation and modality
- Adaptation of structure

Adaptation of content

Adaptation of Content describes methods for personalising the content of hypermedia objects and pages in accordance with user, usage and environment data.

- Personalization functions of content adaptation
- Techniques for content adaptation

Adaptation of content - Personalisation functions

Personalisation functions	Explanation
Optional explanations	help users who lack the necessary background knowledge better understand.
Optional detailed information	can improve the relevance of a hypermedia page for users who are interested.
Personalized recommendations	inform users about available offerings in which they may be interested.
Theory-driven presentation	adaptive comparison that relates new information to a user's knowledge or specific interests
Optional opportunistic hints	are based on users' presumed interests and on current circumstances. Eg: news flashes

Adaptation of content - Techniques

Techniques for content adaptation

A number of techniques on different levels of granularity and localisation have been developed so far for adapting hypermedia content to different user needs.

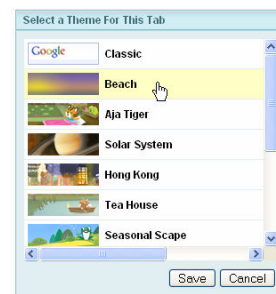
- Page variants
- Fragment variants
- Fragment coloring
- Adaptive stretchtext
- Adaptive natural-language generation

Adaptation of content - Techniques

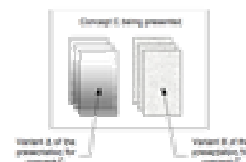
Page variants

Authoring different versions of all pages in which adaptation occurs

- Adaptation at runtime is confined to adaptive page selection.
- Cumbersome since a completely new page has to be written for each variation of local adaptations that may occur on a page
- Inflexible since many pages have to be modified if a single local adaptation is changed



iGoogle

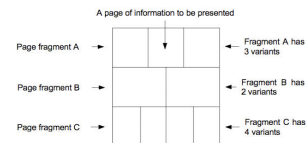
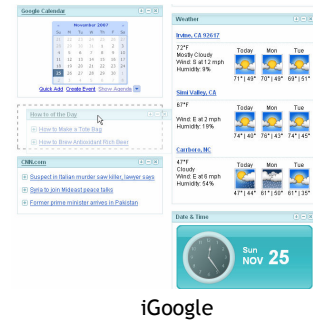


Adaptation of content - Techniques

Fragrant variants

Authored for each adaptive page fragment

- At runtime, the appropriate fragments are included into a static page frame.
- It requires the dynamic generation of web pages at runtime.
- The granularity of a page fragment
 - A paragraph of text
 - An image
 - A table
 - A video



Adaptation of content - Techniques

Fragrant colouring

- The content of the hypermedia remains unchanged across all users.
- For each individual user **certain elements** of the hypermedia presentation **are marked out**, e.g. as being important, irrelevant or too demanding for him or her.
- Fragment colouring can only be applied in such areas where content can be presented in the same formulation to all users, and where the variability of adaptation across all users is relatively low.

Adaptation of content - Techniques

Adaptive Stretchtext

- Stretchtext is “elastic” text that the user can extend or collapse by clicking on it with the mouse
- Stretchtext can be automatically expanded and collapsed by the system, taking the user model into account.
- Users can adapt the page content manually if the adaptation that was automatically performed by the system is not appropriate or desired.

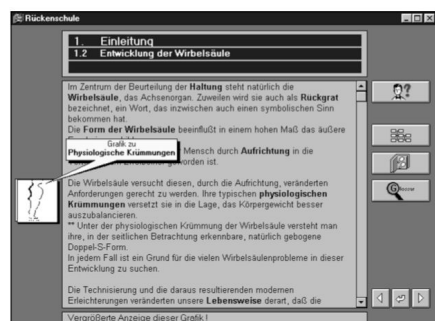
Adaptation of content - Techniques

Correct spelling and grammar

Word provides two ways to check spelling and grammar:

- As you type, Word can automatically check your document and underline possible spelling and grammatical errors. To correct an error, display a **shortcut menu**, and

A menu that shows a list of commands relevant to a particular item



The screenshot shows a software window titled 'Rückenschule' with a table of contents on the left. The main text area displays a paragraph about the human spine. A shortcut menu is open over the word 'physiologischen', showing options like 'Wörterbuch', 'Grammatik', and 'Rechtschreibung'. A callout box explains that Word provides two ways to check spelling and grammar: automatically underlining errors and displaying a shortcut menu for correction.

Figure 7 KN-AHS adaptive hypermedia course "Rückenschule"

Adaptation of content - Techniques

Adaptive natural-language generation

- Natural language generation techniques to create alternative text descriptions for different users.
- A simple approach are text templates with slots that can be filled with descriptions of different complexity based on the user's level of expertise
- Natural-language generation also seems to be a promising complement to stretchtext.

Adaptation of content - Techniques

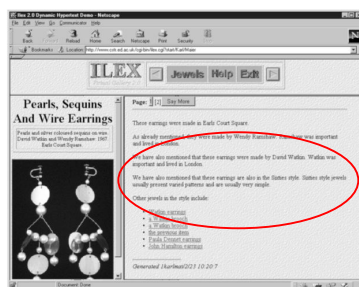


Figure 9 Text presentation to a visitor with no specific interests from ILEX, 1999; reprinted with permission)

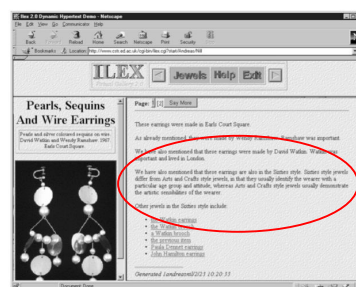


Figure 8 Text presentation to a user with an interest in styles (from ILEX, 1999; reprinted with permission)

Generates interest-tailored descriptions of objects which are tuned to different user interests.

Adaptation of presentation and modality

Adaptations of presentation are adaptations where the information content of the hypermedia objects ideally stays the same while the **format** and **layout** of the objects change.

Change of modality - images to text, from text to audio, or from video to still images.

Adaptation in hypermedia systems concerning multimedia presentations are often based on

- User's preferences
- User's physical abilities
- System performance

Adaptation of presentation and modality



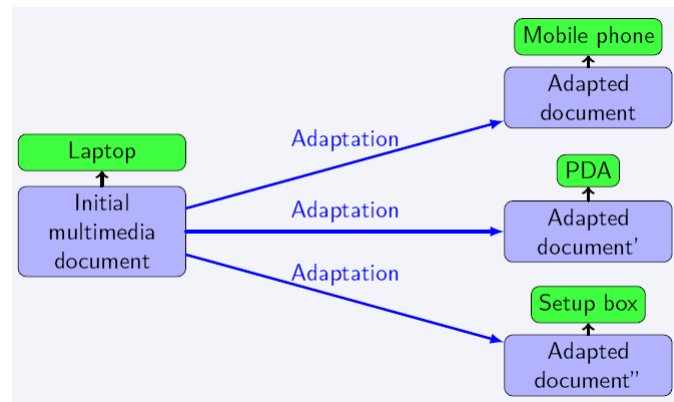
Figure 10 AVANTI Siena map in graphical form



Figure 11 AVANTI Siena map for blind people (visual representation of auditory output)

Modality “image” has been changed to “text” based on the selection of different modalities by the user’s physical abilities.

Adaptation of presentation and modality



Adaptation of structure

Adaptation of structure refers to changes in the way in which the link structure of hypermedia documents or its presentation to users is changed.

Techniques for structure adaptation: -

- Adaptive link sorting
- Adaptive link annotation
- Adaptive link hiding and “unhiding”
- Adaptive link disabling and enabling
- Adaptive link removal/addition

Adaptation of structure - Techniques

Adaptive link sorting

Primarily employed for ranking the target web pages based on their relevance to users' interests and goals, and their appropriateness for the user based on the user's background knowledge.

example: -

- ranked lists of recommended items, such as movies
- ranked lists of recommended items as technical equipment
- frequency of use, e.g. in personalised views and spaces

The sorting of link lists can be used for non-contextual links only.

Downside: - Caution should be exercised, however, since automatic item sorting in menus based on usage frequency has been found to potentially confuse users

Adaptation of structure - Techniques

Adaptive link annotation

Links that have already been visited change their colours. This is non-adaptive link annotation is well known from all major web browsers

There are up to six different annotations with the following meanings: **suggested, ready, inferred, known, done** and **not-ready**.

Adaptive hypermedia systems use different colours and symbol codes to annotate links in a personalised manner.

Adaptation of structure - Techniques

Adaptive link hiding/unhiding

Adaptive link hiding removes the “visible cue” of a link in such a way that the link anchor looks like normal text or a normal icon.

The idea is to visually reduce the hyperspace to support users' navigation, and to guide users to those pages which the system assumes to be the currently most relevant ones or that are probably comprehensible to the user given his or her presumed level of knowledge.

Adaptation of structure - Techniques

Adaptive link disabling and enabling

Link disabling removes the functionality of a link but leaves its visual appearance nearly untouched (i.e. the link anchor still looks like a link, but nothing happens when one clicks on it).

[Disabled Link](#)

Downside: - This behaviour of a link considerably violates the principle of expectation conformance in human-computer interaction, link disabling and enabling is currently used together with link hiding and unhiding only.

Adaptation of structure - Techniques

Adaptive link removal/addition

Adaptive link removal deletes the link anchors completely. It is an effective way to support users' navigation by reducing the number of navigation steps to achieve a certain goal and by reducing the user's cognitive overload. This technique can only be applied to non-contextual links.

example: -

- removal of links to pages which are not yet appropriate for a learner
- removing links to irrelevant subtasks
- removing items in a product listing that are probably of no interest to the user

Downside:- if a stable listing of links is used frequently, removal of individual links would also violate the constancy principle of human-computer interaction and should therefore be used with caution.

Adaptation of structure - Techniques

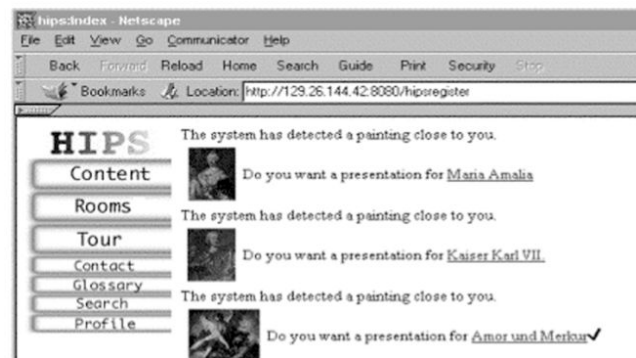


Figure 12 Recommendation of nearby paintings in HIPS (HIPS - Mobile web-based Museum guide)

Link addition - system automatically introduces links to nearby paintings and also links to more distant paintings based on user interest in their topic, painter and time periods of paintings that the user visited before.

Adaptation of structure - Personalisation functions

Some personalisation functions of structure adaptation

- Adaptive recommendations.
- Adaptive orientation and guidance
- Personal views and spaces

Adaptation of structure - Personalisation functions

Adaptive recommendations

Recommendations concerning products

Lists of links to “products” and services are filtered or ranked based on user data, and presented to the user.

- Amazon.com, moviefinder.com.

Recommendation concerning information

Lists of links to documents or other pieces of information are ranked based on user and usage data

- Recommended news - Google news.

Navigation recommendations

Links to hypermedia pages (usually at the same site) are filtered or ranked based on user, usage and environment data.

- Systems customised for different user profiles.

Adaptation of structure - Personalisation functions

Adaptive orientation and guidance

Overview maps

Personalised overview maps mark those pages that users visited or bookmarked in the past.

Guided site tours

Personalised guided tours can take user data into account and modify the tour so that it caters better to users' presumable interests. It helps in familiarising first-time users with the basic offerings of a website.

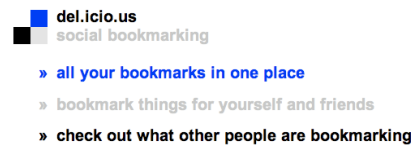
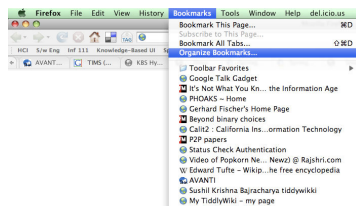
Personalised next buttons

This is a very flexible method for the presentation of learning material because the destination node of the next button is not directly connected to the current node but can be dynamically computed at runtime, taking even the very last actions of the user into account.

Adaptation of structure - Personalisation functions

Personalised view

- bookmarking facilities that are integrated into most current web browsers provide users with personalised access to web resources
- generate shortcuts for frequently followed links



Adaptation of structure - Personalisation functions

Personalised Space

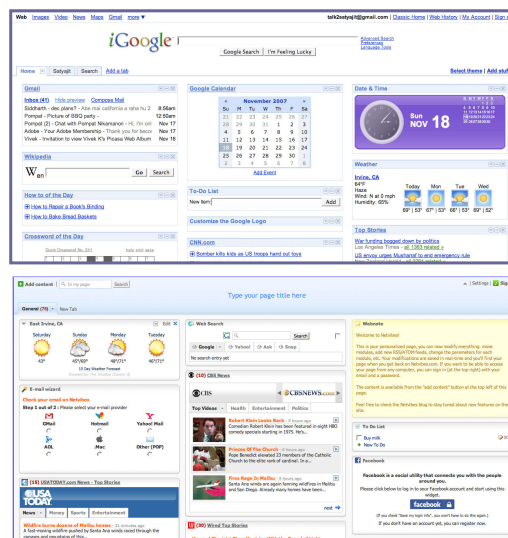
- view histories of their past actions (e.g. purchases and reservations)
- set markers (e.g. for books to buy in the future)
- define shortcuts to site-specific resources they frequently access
- specify information they want to have forwarded to them automatically (e.g. quotes for certain stocks, news from certain categories)
- save documents and news in a personal repository.

Adaptation of structure - Personalisation functions

Personalised Space

iGoogle

Netvibes



V. Conclusion and prospects

- Public websites
- Information kiosk
- Ubiquitous access opportunities for customers
- “Universal access”, “Design for all”, “User interfaces for all” with respect to computer systems

Public websites

- Objectives are to keep visitors at the site, to turn them into customers and to make them come back.
- Different types of support must be given to first-time visitors, returning visitors, and infrequent and frequent users of the website.



Information kiosks

- Fairs, exhibitions, showrooms, and public places. System needs to support “walk up and use” by first-time users or infrequent users.
- An integrated approach should be pursued where the adaptation of content and presentation format is also based on the different hardware and software environments and the different locales.



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Ubiquitous access opportunities for customers

- Web-capable appliances and web-capable mobile devices like car-mounted displays and portable digital assistants integrated with telephone functionality

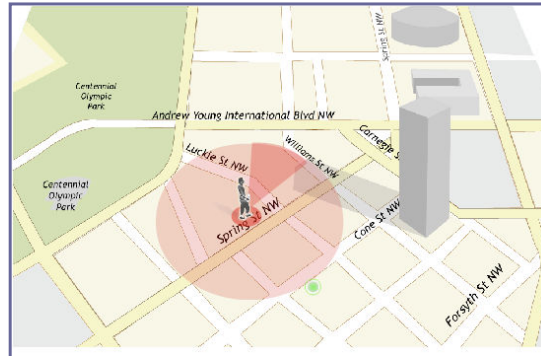


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Ubiquitous access opportunities for customers

- Embedded devices that have access to data from their physical environments can provide the basis for adapting information to the current needs of individual customers, such as providing a list of dealers closest to their current location.



Wigglesick, Mobile Technologies Group, Georgia Tech

Universal access

**“Universal access”, “Design for all”, “User interfaces for all”
with respect to computer systems**

- (Shneiderman, 2000; Stephanidis, 2001)

- Software systems should be designed in such a way that they pose no access barriers to people with special needs, such as users with disabilities, elderly users and users with different cultural background.
- Specialized systems (such as screen readers or web browsers for the blind) vs. Generic applications (adapt to the needs of these different special audiences)

Questions and Discussion

