

The News Wall: Serendipitous discoveries in dynamic information spaces

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ABSTRACT

We present the news wall ambient display designed for continuous exposure to news information. The display benefits the elderly and people with special needs as it maintains a prolonged contact with news information. Since the display is not interactive, it capitalizes on serendipity rather than user feedback to communicate interesting information. The display's effectiveness depends on the frequency of occurrence of serendipitous discoveries. We describe how the deployment environment influences serendipity and investigate manners to increase its occurrence by design. A heuristic evaluation technique is presented to assess the news wall's serendipitous effects.

Author Keywords

Ambient displays, serendipity, ubiquitous computing, heuristic evaluation.

ACM Classification Keywords

H5.2. User Interfaces (D.2.2, H.1.2, I.3.6): Interaction styles, Evaluation/methodology.

K.4.2. Social Issues: Assistive technologies for persons with disabilities..

INTRODUCTION

News sites such as Yahoo News and BBC News publish several thousands of news stories daily, covering major local and international news categories. Such dynamic information space of news articles changes as new stories get published and old ones deleted or archived online. This ever changing environment requires a prolonged dedication of time and effort to maintain acquaintance on a daily basis with its content. This is a specially demanding task for people with low locomotion who face difficult access to

dynamic information spaces. Part of this access difficulty lies in the burdens of the navigation process that requires users to make navigation decisions, remember how to use each site's categories and menus, and filter the information already visited from new information, all this while seeking information that relates to their interests. This information process fits well for users who are retrieving a specific piece of information. However, when contact with information is prolonged, the physiological and interaction aspects become a burden, especially for persons with physical disabilities.

We introduce the news wall ambient display designed for continuous exposure to news information. The display lies in periphery of its spectators, broadcasts information unobtrusively, and coexists with ongoing activities. The display's characteristics allow spectators to consult the display effortlessly while attending to other duties.

The design approach taken during the news wall development aims to increase the frequency of occurrence of serendipitous discoveries, and consequently its efficiency. The display capitalizes on the effects of serendipity to communicate news information that is relevant to the interests of its spectators. The display does not rely on feedback from its spectators, as it does not require any user interaction, thus it can be deployed in several types of environments.

We start by defining the role of serendipity in the first section and argue about the manner by which serendipitous discoveries can be stimulated. We discuss how it is possible to rely on the effects of serendipity in the absence of interaction, and argue how exposure to the display depends on environmental factors. The second section outlines how the display's GUI design can influence its performance. The third section talks about evaluation heuristics for estimating the effects of serendipity and its frequency of occurrence, and the evaluation methodology is briefly discussed. Finally, we consider several deployment scenarios for the news wall and argue about its benefits to the elderly and people with special needs.

News Aggregation Overall description

The display's engine aggregates news articles from different sources to create and update its information space.

The system then identifies the topic clusters and sub-clusters of articles inherent in the space by using semantic analysis technique on the space's semantic properties.

The news wall graphical user interface (GUI) visualizes elements within a certain topic similarity range from the display's engine. The display presents a clustered representation of news floating on a watery surface. The representation is composed from elements that lie inside the visibility scope of the space engine's topic. This range is called visibility scope, and may involve several news clusters at the same time.

The engine moves between topics continuously following a closed path composed from the topics that it selects to visit. At the end of every loop, the space is updated with newly published stories and old stories are removed, and the navigation path is recalculated before the whole process starts again.

RELATED WORK

Plaue et al evaluated the ability of ambient displays to communicate information at a glance and found that people note and recall more information with ambient displays than with other kinds of displays [10]. Among others, Laakso et al surveyed and categorized experimental and commercial displays [3]. According to their descriptions, the large majority of ambient displays address data that is composed of a single variable such as temperature, time, and scale. Some displays, such as the Weather Tank and MoneyColor projects, have successfully visualized multivariate information. The Weather Tank display advises sailors about the overall status of the weather before sailing [7]. And the MoneyColor display represents the status of several auctions in the stock market symbolically through a painting visualization [12]. The complexity of news information may even surpass that of stock exchanges since it is composed of media elements such as text and images rather than numeric values.

Ambient displays are also becoming part of the urban environment's architecture as architects are embedding information flows inside their structural plans [14]. Hence, as information becomes more ubiquitous, transmission methods need to adapt towards less interaction and more explicitness. Research indicates that slow information systems are those that dialogue with humans at their own pace and procreate calmness by remaining unobtrusive to their activities and their environments [1]. Such systems are manifested by the informative art displays developed by Redström et al [11] at the PLAY institute. These displays also demonstrate the potential of serendipity in the transmission of information in ambient settings for their lack of interaction. The effect of serendipity is capitalized upon by several applications such as Collage Machine, a composer of generative information spaces developed by Kerne et al [5]. This machine allows users to collect and filter media elements fetched from the internet in order to compose collages. Although the user can specify

preferences as to the types of elements to fetch, serendipity plays an important role in obtaining interesting elements or elements relevant to the conceptual design of the collage apart from its thematic design.

AMBIENT DISPLAY

The provision of a prolonged contact with news information cannot be based upon the constant availability of user attention. Therefore peripheral displays use people's peripheral attention to notify about the status of dynamic information. This contact with information is a persistent process that stretches and develops throughout the relationship between the display and its spectators. This signifies that during situations where the observers are absorbed by something else, the display's interface tries to maintain an indirect informative channel through their peripheral attention. Peripheral displays are known to diffuse information continuously without interfering ongoing activities and their surroundings.

To maximize the display's efficiency, the transmitted information should be of significance to the observers. In the absence of user interaction cues, identifying the person's interests unobtrusively becomes a complex and daunting task as their interests change dynamically while the person gets affected by newly published news articles.

In these settings, serendipity can play a role in connecting people with interesting information. It is characterized by the frequency of occurrence of fortunate discoveries that satisfy the person's interests or provoke their evolution towards new topics.

SERENDIPITOUS DISCOVERIES

With the absence of user interaction, the information broadcasted by the display can match with its spectators' interests only by coincidence. Although this coincidence might not be frequent, it does not require any effort from the part of the person, and offers potential benefits in proportion to its frequency. Serendipity refers to the resulting benefit from an accidental discovery of something auspicious without any dedicated effort. So far, serendipity has been regarded as of little or infrequent influence to information retrieval, especially if the retrieval process is convergent on a specific information object. However, serendipity can play an influential role when the inquiry is of a divergent nature and does not seek a well defined object. In fact, M.K. Stoskopf [13] argues about serendipity's "significant value in the advancement of science" as numerous life-changing discoveries, such as Isaac Newton's gravity and Archimedes' method for calculating specific density, were made serendipitously.

In the context of news exploration, the inquirer's interests are broad and the inquiring process is elongated over time, raising the chances of mating between broadcasted information and the spectators' interests as argued by Leong et al [5]. An inspection of famous serendipitous discoveries also shows that these happenings take place in

the peripheral attention, like Newton’s apple which inspired the theory of gravity. In fact, ambient displays often stimulate small serendipitous discoveries. The information they broadcast affects people by notifying them subtly about important issues, even momentarily. Therefore, increasing the effect of serendipity by boosting its frequency of occurrence can extend the utility of these displays further.

Environment factors influencing serendipity

The news wall display can be deployed in three different environment types: private, semi-public, and public. In private environments such as hospital rooms, a patient’s exposure to the news wall is elevated. When residing in a hospital bed, the patient may consult the display frequently as it resides in its vicinity for prolonged periods. On the other hand, the display is consulted less frequently in semipublic environments, as the individual exposure time is lower than private environments such as the workplace or retirement centers. In contrast, the increasing mobility of people in public spaces challenges the deployment of ambient displays that require prolonged contact with their spectators. It is more common to install them in settings like waiting rooms, public transportation, or restaurants where individuals are bound to spend some time and the environmental characteristics resemble semi-public environments.

Two factors influence the frequency of occurrence: the spectator’s exposure to the display, and the display’s ability to profit from the amount of granted attention in order to communicate interesting information. Exposure can be approximated in terms of two environmental factors being the average frequency of consultations (n) made by a person and the average daily amount of time (e) that this person spends in the display’s vicinity. Although these factors cannot be directly controlled by the display, their values can be taken into consideration in the design of its interface in order to provide an adequate prototype for each environmental setting.

We define the heuristic $exp = Tg \times (n \times e)$ as the person’s daily exposure to the broadcasted information, where Tg is the average amount of information that the person grasps at a glance from the display. The value of Tg tightly reflects the salience of the display’s interface and is therefore controlled by the interface’s specifications rather than by environmental factors. Table 1 shows the variation in these factors for different environments as function of Tg .

Environment	N	e	exp
Hospital	20-30	15h	$(300-400) \times Tg$
Workplace	10-20	8h	$(80-160) \times Tg$
Waiting room	30-40	<30 min	$(15-20) \times Tg$

Table 1. Variation of exposure by type of environment.

SERENDIITY DESIGN CONSIDERATIONS

From a design perspective, the occurrence of serendipity depends on the capacity of the display’s GUI to communicate a large set of interesting news stories to its spectators without overloading them with information. Hence, in order to increase the display’s serendipitous effect, the average amount of information Tg grasped at each glance (or the interface’s salience) should therefore be maximized. This correlates with two broad design factors being the selection methods that nominate elements to broadcast and the manner by which these elements are visualized on the display.

Selecting information for ambient transmission

Categorizing the space’s content and developing a relational model among its elements improves the performance of selection methods that determine which elements ought to be broadcasted as well as their broadcasting order. The information space’s semantic properties permit the clustering of its elements into categories and subcategories, measuring the importance of each in the space, and calculating proximity values among them. This is accomplished through the use of Latent Semantic Analysis [4] and term frequency–inverse document frequency (TF-IDF) [2] but their discussion lies outside the scope of this paper. The space and its semantic representation are periodically updated at the end of every navigation cycle.

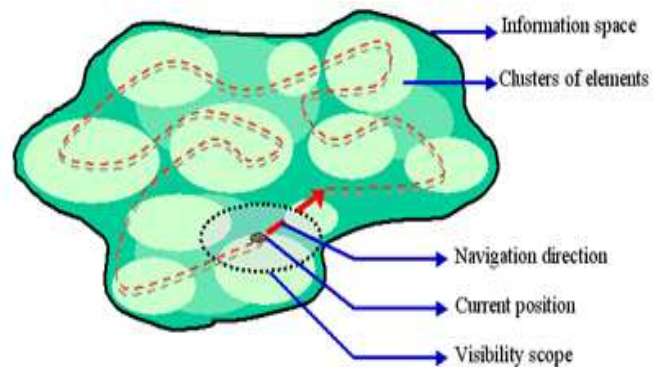


Figure 1 NewsWall’s engine elements positioning and navigation metaphor

The nature of the news wall display imposes restrictions on the amount of information it can transmit. Many of these restrictions are drawn from the human psychophysical limitations in ambient settings such as the levels of cognition through peripheral attention and memory limitations. During direct engagement with information, people are able to manipulate up to seven different objects at the same time as the experiments of Miller showed [9]. Consequently, the display’s interface design focuses on the manner information is represented and how it is animated to create the suitable visual settings for serendipitous discoveries. Therefore, the display is designed to broadcast one information object at a time in order to respect its

spectators' engagements with other tasks in its vicinity, see Figure 1.

Ambient information visualization

A news wall engine forms the news visualization by reading the feeds of news agencies and other frequently consulted sources, and aggregating them into one information space. In order to notify people in its vicinity about developing stories, the display's GUI try to utilize effective visual guidance [15] to pass information about relative change of information at an explorer's glance without insistence. Its interface metaphor is based on the idea that water can symbolically represent an interface between people and information spaces. Water is known for its ability to lure people's attention and provoke relaxation and enjoyment. Its surface constitutes a penetrable disjuncture between a person on one side and a translucent dark depth on the other. It is being increasingly employed in the production of cinematic special effects as an attractive border zone or a travelling gate between two different words. Hence the aesthetic appeal of water is capitalized upon in order to attract more attention and provoke more consultations to the display.



Figure 2 Water visualization metaphor: Departing images and keywords sink while inbound ones surface.

In order to increase the penetrability of the visualized information, lowering the effort required to grasp can be accomplished by using an effective representation approach. Kerne et al [6] have shown that collage surrogates composed of extracted features are efficient for representing topics in a navigation task with divergent interests. Based on that, we developed a method that automatically composes surrogates for each semantic topic in the space. As the engine moves from one topic to another, media elements (images and keywords) extracted from the news articles relevant to its current position are used to create a representative collage composition. The selection of these media elements is determined by an algorithm that assesses their discernability, expressiveness, and semantic distance from the centroid of the current engine's position. Hence, the news wall's interface shows

an evolving cluster of media elements floating on top of a blue water surface. Floating elements are associated with the surface within reach, and the translucent elements of smaller scale represent symbolically items that are sunk further in the depths. As the engine progresses along its navigation path, the displayed cluster changes as departing images and keywords sink while inbound ones surface. Elements in the depth move slowly from right to left, as well as those that are surfacing and sinking. The remote background layer where these elements reside makes the motion of the news wall's engine visible and therefore amplifies the presence of time. The surface hence acts like a magnifying glass that reveals the sunken elements as the engine navigates through the space. Figure 2 shows a caption of the news wall display's GUI.

EVALUATING SERENDIPITY

In order to assess the display's serendipitous aptitude, we have adopted a set of heuristics to track in the experimental frameworks of the display's deployment. From the heuristics for evaluating ambient displays proposed by Mankoff et al. [7], we have chosen those relevant for the news wall design and refined them accordingly. To those, the daily exposure heuristic previously described was added. Table 2 explains in detail these heuristics and the subjects they tackle.

Heuristic	Definition	Subject
Daily exposure	the observer's daily exposure to the broadcasted information	Environmental characteristics
Sufficient information design	The GUI should convey just the right amount of information	Interface and information design concepts
Legibility, ease of use	The speed by which the observer assumes the visualized information	Interface and information design concepts
Visibility of state	The position of the engine in the space and it's progress should be clear.	Interface and information design concepts
Aesthetic appeal and pleasing design	The display should have a positive impact on its deployment environment	Interface and information design concepts

Table 2. Set of evaluation heuristics for serendipitous aptitude of ambient displays.

The daily exposure and interesting information heuristics can be measured empirically or experimentally. This is not true for the remaining four heuristics that need to be evaluated by qualitative means. Hence, the strength of the

display's serendipitous effect can be now approximated by applying a mixed qualitative and quantitative evaluation plan that can provide information about the display's performance and its effects on the deployment environment.

DISCUSSION

The news wall can maintain the spectator's liaison with the outer world and provide news-related materials to stimulate the brain and maintain mental activity. Serendipitous discoveries help elderly people to practice memory recall and may potentially reduce their isolation from the outer world by continuously transmitting fresh news stories. It does not necessitate any interaction and assimilating the information it broadcasts requires little cognitive effort due to its design features. In social settings, it can foster interaction between people in their clubs and social centres and help its spectators identify common interests. In fact, discussions can start between two or more persons whenever the information broadcasted by the display addresses a common interest, hence providing material for discussion.

As previously argued, the news wall can potentially be deployed in different environmental settings ranging from private to public. For example, in private settings, the display can reduce the feeling of isolation or imprisonment of patients in their hospital rooms or that of the elderly in their homes, by providing a continuous flux of fresh information about the latest developments in the outer world. In semi-private environments the display capitalizes on social relations to create social interaction. On the other hand, the role that the display can play in a public environment is ambiguous due to the potentially obstructive environmental settings. For example, in public transportation the contact that people have with displays is short-lived, however they tend to glance frequently at displays because of the lack of social interaction. In these settings, it is also difficult to evaluate the display's effects on its spectators.

CONCLUSION

We have presented the news wall ambient display and have argued that serendipity plays an important role for discovery and exploration of information spaces. Serendipitous exploration allows people to maintain a prolonged exposure to news information and facilitates access and assimilation its content. The paper discussed several design considerations related to the deployment environment. These considerations emerged from scenarios ranging from individual interaction, such as a hospital bed, to public spaces. Finally, a heuristic framework for evaluating serendipity effects in multiple of settings has been described.

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