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Ambient Browser: Web Browser for Daily Use

Satoshi NAKAMURA † Mitsuru MINAKUCHI † Katsumi TANAKA † ‡

† National Institute of Information and Communications Technology, Japan

‡ Kyoto University

Abstract We developed a Web browser called the *AmbientBrowser* system that supports people in their daily acquisition of knowledge. It displays Web pages that have been selected using preset keywords and Web search services on a ubiquitous display where these are in locations, such as kitchens, bathrooms, bedrooms, studies, offices, and streets. It monitors the context of the environment, such as lighting conditions, and temperature. In addition, it displays Web pages incrementally in proportion to the context. Thus, the user can fast-forward or slow-forward the displayed page through a simple interaction. This paper describes the implementation of the *AmbientBrowser* system and discusses its effects.

1. Introduction

In the words of Bertrand Russell, "*there is much pleasure to be gained from useless knowledge*." People want and enjoy knowledge acquisition. In Japan, one of the most popular television programs "*Trivial Fountain* (*Toribia no Izumi* in Japanese)" provides a variety of trivial knowledge to viewing audiences. We believe that intellectual stimulus is important to people and new knowledge will make their lives richer and more enjoyable.

Many people acquire a great deal of knowledge from books, magazines, newspapers and posters and so on. These media vehicles can be divided into movable and immovable media.

- Movable media (e.g., books, magazines, and newspapers and so on)
- Immovable media (e.g., posters, advertising displays, and guide plates and so on)

When people begin to read movable media, they have an explicit motivation to do so. When people start to read/watch immovable media, on the other hand, they have a lower motivation to do so than reading movable media vehicle, in many cases. We may say that the former is active browsing and the latter is passive browsing. We believe that the passive browsing is suitable for daily knowledge acquisition because, in our daily lives, we either relax or get involved with numerous activities. In addition, the variety of knowledge acquired by passive browsing (immovable media) may be greater than that by active browsing (movable media) because the passive browsing targets all the information within the user's range of vision and the acquisition style is heuristic. However, people cannot acquire much knowledge with a second browsing because such immovable media are static.

The ubiquitous computing environment is becoming a reality [9] due to the recent remarkable advances with computer technology. People can directly obtain information from ubiquitous computers through ubiquitous displays. There are many electronic billboards that provide news information dynamically to people who are waiting. They can acquire information naturally and pass away idle hours. However, almost electronic billboards provide headline news, weather news and advertisements only. In addition, it is difficult for people to read/browse rich information from them because almost electronic billboards only have a single line display for text representation and the displayed text disappears at once. Some past researchers have used ubiquitous displays to present an atmosphere of information, such as that acquired through pictures and so on [1,2,3,4,5,8]. However, they did not assume that they were providing richness and large variety of information.

Consequently, the main objective of our work is to achieve a mechanism that can provide a huge variety of richness in the form of peripheral information to people in their daily lives. We assume an environment surrounded by ubiquitous displays where these are in locations, such as kitchens, bathrooms, bedrooms, studies, offices, and streets. These displays are controlled by computers that are connected to the Internet and we use them to provide peripheral information. We also use Web pages as peripheral information because there are an innumerable number of valuable Web pages in the World Wide Web (WWW). We use the Web search engine and some

keywords about spatiality, people's preference and so on in order to select the target Web page. In addition, we use the gradual Web rendering mechanism to represent for easy viewing and to leave the displayed text for a certain time.

In this paper, we propose the *AmbientBrowser* system and explain about the design and implementation of the *AmbientBrowser* system. In addition, we discuss the effectiveness of the *AmbientBrowser* system.

2. Ambient Browser

2.1. Ambient Information

We believe that ubiquitous displays should have their own distinctive characteristics and roles because people can understand and acquire knowledge naturally if information that is provided by ubiquitous displays is related to their location or space. For example, someone in an aquarium can understand the ecology and the characteristics of fishes easily if the ubiquitous display in an aquarium shows information about them. Someone in a grocery shop can imagine the nutrition of foods and the cooking easily if the ubiquitous display in a grocery shop shows information about foods, drinks and cooking and so on. In the same way, ubiquitous displays at entrances should have information about doors, shoes/boots, and weather on users' outings. Ubiquitous displays on trains should have information about trains, time tables, travels, and local events.

Ubiquitous displays may also have to reflect people's preferences for what information is to be provided. For example, if someone near a ubiquitous display wants information about sports news, football, basketball, or baseball news may be provided. When people near a ubiquitous display want information about food, restaurant, grocery-store, or cooking information may be provided.

To fulfill these requirements, we used various keywords and a Web search engine, such as Google search[1]. Our system selected target Web pages through keywords and these Web search engines. The keywords were divided into two types as follows:

- Keywords for ubiquitous display (Each ubiquitous display had several roles related to spatiality. For example, a ubiquitous display in the kitchen had "kitchen", "food", "cooking", "water", and "drink" as keywords. A ubiquitous display at an entrance had "shoe", "boot", and "weather" as keywords. In addition to these, locality keywords such as "Tokyo" and "Osaka" could have been used. These keywords are set by the owner.)
- Keywords for people's preference (Individuals have interests in various things. If someone has an interest in football, pasta, or Italian wine, these words are set as keywords. If someone has an interest in topical news, cake, or scuba diving, these words are set as keywords.)

When the *AmbientBrowser* system selects a target Web page, it first randomly decides the number of keywords for the Web search by using a preset range of values. It then randomly selects various keywords from the ubiquitous display's reference keywords and people's preference keywords. It posts the selected keywords to the Web search engine to create an URL list of search results, and randomly selects the target Web page from the URL list. If the target Web page was displayed within the past few hours, it reselects the target Web page.

The target Web page (ambient information) is selected through these processes

2.2. Gradual Web Rendering

Typically, browsing the Web requires active reading. In other words, the reader has to focus on following the text. He or she also has to manipulate the browser to update the pages being displayed by using the scroll bar or clicking on various links. This active browsing style, however, may not be suitable for everyday use. Most of the various activities we do daily do not involve sitting in front of a computer. It is difficult to operate a computer to browse Web pages using traditional interactive user interfaces that require direct manipulation, such as graphical user interfaces. Additionally, the user may find these operations tiresome when he/she is relaxing.

The conversion of Web pages into a TV-program-like format (text to audio, camera action and avatar motion) [6] may be useful while relaxing in daily life. A TV program has time-based content, that is, its representation proceeds automatically as time elapses. Users can thus watch content with no operations required. They can also watch time-based content actively by adjusting the current timing for playing time-based content. However, TV-program-like representation is not suitable for ubiquitous display environment because ambient information which was provided by TV-program-like

[1] http://www.google.com/

representation may become ambient noise by its voice. In addition, it cannot leave information for a certain time.

In order to provide ambient information for many people in any place naturally, we take account as follows:

- Passive browsing
- Easy viewable representation
- Natural interaction

Hence, by extending the concept of a time-based representation of content, we introduced a gradual Web rendering mechanism as the core mechanism for the *AmbientBrowser* system based on an abstract parameter that could be connected to various statuses or inputs (temperature, time, intensity of illumination, and energy consumption).

The gradual Web rendering mechanism first selects the target Web page and acquires the selected Web page from the WWW. It then divides this Web page into many parts and serializes them (see Fig. 2). After this, it monitors the values for status or input from sensors or input devices, and converts them into a part of the Web page. Finally, it renders part of the Web page after conversion (see Fig. 3). If the displayed fragment exceeds the size of the display area, it scrolls down the display area automatically. People can change their reading (browsing, rendering) speed by adjusting the parameter given by the sensor's output with this system. In addition, it can leave information for people for a certain time.

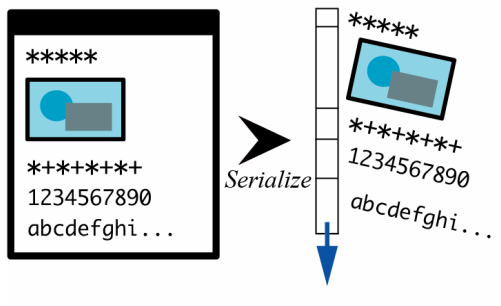

Fig. 2. Serialization of Web page.

If we use brightness as input parameters, the higher the brightness, the faster the browser displays Web pages, and vice versa. Users can adjust the rendering speed by turning on a light at the sensor, or by shading the sensor with their hand. When the brightness is under a specific threshold, the *AmbientBrowser* system reduces the value of the parameters. Thus, the user can fast-forward or slow-forward the displayed page through a simple interaction.

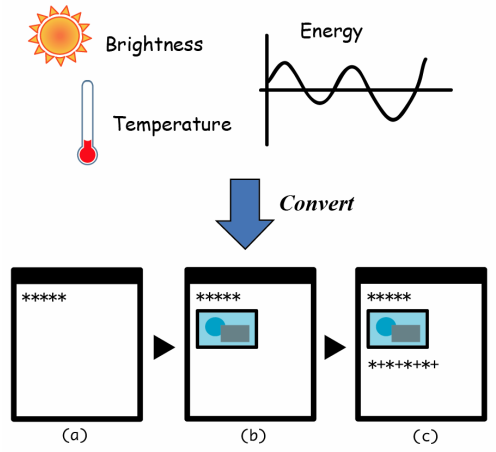

Fig. 3 Gradual Web rendering.

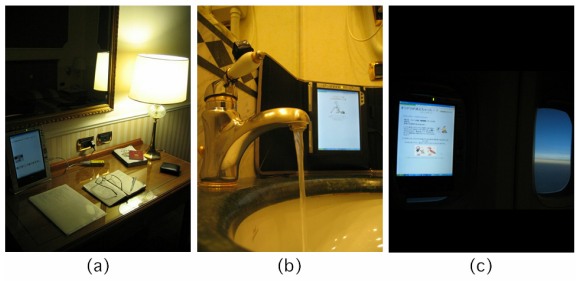

Fig. 4 (a) *AmbientBrowser* system uses brightness sensor as parameter in study room. (b) It uses running faucet as parameter in bathroom. (c) When embedded display in window was used, it used user's eye view as parameter.

Figure 4 shows three setting situations of the *AmbientBrowser* system. In the figure 4 (a), it exists in study room. In this situation, the owner uses brightness sensor as parameter. User can see a Web page which was provided by it vaguely at intervals of work. When he/she gets interested in a displayed Web page, he/she can read slowly by locating his/her hand on the sensor. In the figure 4 (b), the *AmbientBrowser* system exists in bathroom. In this situation, the owner set running faucet for input parameter.

3. Implementation

Figure 5 outlines the core mechanism for Web selection by the *AmbientBrowser* system. In this implementation, we used the Radio Frequency Identification (RFID) to detect users. We also used a keyword list that was created by the user from the WWW to acquire his/her preferences. We could set common keywords in the keyword list and the URL for the RSS (RDF site summary), such as the news site and weblog site.

Each ubiquitous display's owner first sets its

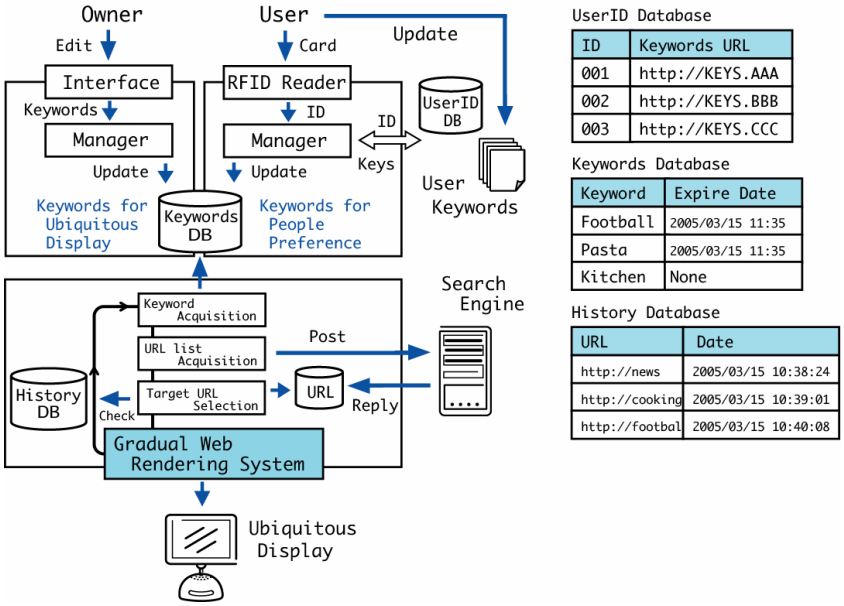

Fig. 5 Core Mechanism of Web selection for *AmbientBrowser* system.

keywords related to its characteristics. For example, the owner of a ubiquitous display in a kitchen sets keywords like kitchen, cooking, food, or the RSS of a cook's weblog. In addition, the user creates a keyword list on his/her preferences and updates it the WWW and registers his/her card ID with the User ID database with the URL of his/her keyword list.

When the user touches the RFID reader with his/her RFID card, our system detects the ID and obtains his or her preference keywords from a Web page. The manager of the user's preference keyword database checks the keywords and deletes ones that have expired.

When our system has selected the target Web page, the keyword acquisition module first randomly decides the number of keywords for the Web search by using the preset range of values, and randomly selects some keywords from the keyword database. The URL list acquisition module then posts the selected keywords to the Web search engine to create the URL list of search results. If the URL of the RSS was selected as a keyword, it creates the URL list from RSS. The target URL selection module randomly selects the target Web page from the URL list. If the target Web page was displayed within the past few hours, it reselects the target Web page. After these processes, it sends the target URL to the gradual Web rendering system and adds the target URL to the history database.

We can see a photograph of the RFID card and RFID reader in Fig. 6. Figure 7 is a keyword list of the user's preferences on the WWW.

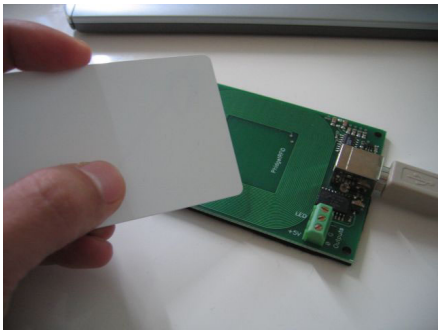

Fig. 6 Registering user's preferences.

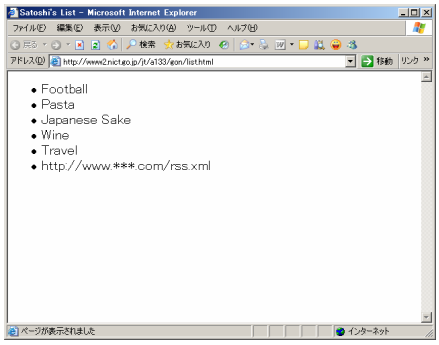

Fig. 7 Keyword list of user's preferences.

Figure 8 outlines the core mechanism for gradual Web rendering for the *AmbientBrowser* system. The system acquires parameters from the sensor and the Web page from the WWW. It formalizes the Web page and renders parts incrementally related to inputted parameters. Figure 9 outlines the scheme for the *AmbientBrowser* system using lighting intensity (brightness). The system consists

of lighting intensity acquisition and lighting intensity conversion equipment and a ubiquitous display.

Figure 10 has examples of gradual Web rendering processes. First, a blank page is rendered. Next, the Web page is rendered incrementally.

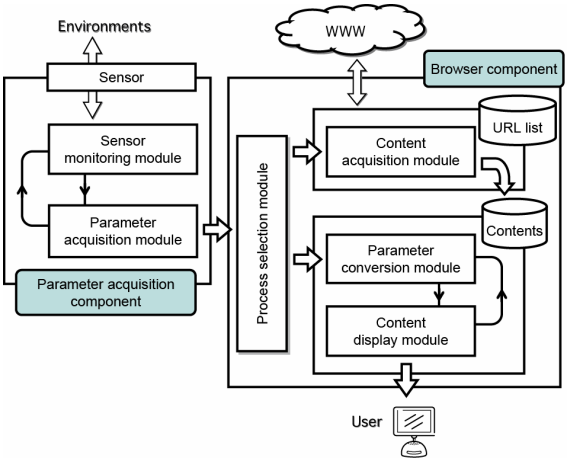

Fig. 8 Core mechanism for gradual Web rendering for the *AmbientBrowser* system.

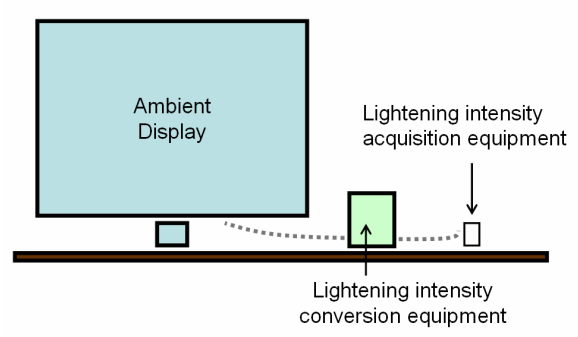

Fig. 9 Scheme for the *AmbientBrowser* system.

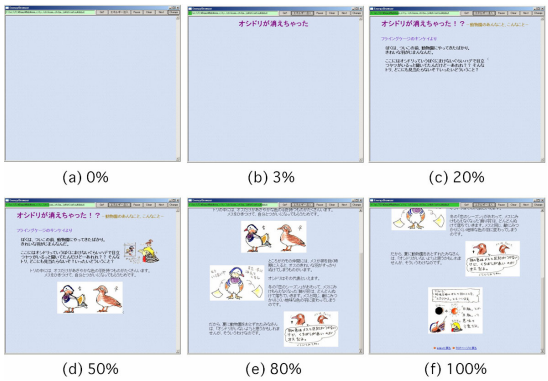

Fig. 10 Example gradual-rendering process by the *AmbientBrowser* system.

We used the VersaPro VY11F/GL-R produced by NEC Corp. as the ubiquitous display and computer, and the WeatherDuck produced by IT WatchDogs Inc.[2] for the brightness, temperature, humidity, and air flow sensor (Fig. 11). We also used the MDP-A3U9S produced by NEC Tokin Corp. as the motion sensor. In addition, we used the RFID reader produced by Phidgets Inc.[3] to detect users near the display. In addition, we used the Microsoft Internet Explorer Web Component for the browser part of the *AmbientBrowser* system. Figure 12 shows the one example of the *AmbientBrowser* system.

Fig. 11 Sensor output.

Fig. 12 The *AmbientBrowser* system.

4. Discussion

We established some *AmbientBrowser* systems in homes and offices (see Fig. 4). From simple field tests, we found that our system provided a great deal of knowledge to people who enjoyed the Web. After the field tests, we found the presentation of Web pages was important. Large font sizes and appropriate typefaces were needed for legibility. Simplified structures were also preferable for the *AmbientBrowser* system because it automatically scrolled down the display area. We found some pages where the pace and volume of speech could be adjusted typographically (Fig. 13). These were

[2] http://www.itwatchdogs.com/

[3] http://www.phidgets.com/

very popular with users because incremental rendering made it appear as though the speech was real. In the next section, we introduce the content-conversion mechanism to modify pages for greater legibility.

Fig. 13 Examples of typographical tone expressions.

Several user comments emphasized the importance of converting Web pages for the *AmbientBrowser* system. Figure 14 outlines two examples of typical site constructions for news and weblog sites. There are many parts in these Web pages that readers do not need to see (those in gray). Removing unneeded parts (such as frames, banner advertisements, and navigation links) increases readability. In addition, the font size can be enlarged to improve readability. We are planning to introduce the removing unneeded parts mechanism.

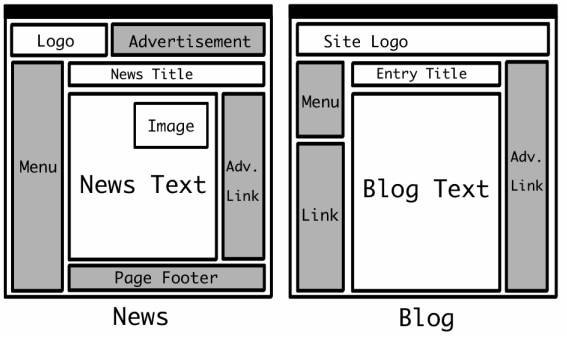

Fig. 14 Site construction examples.

The variation of keywords has limitation in the prototype system because the *AmbientBrowser* system only uses the preset keywords. We can acquire the synonyms of keyword by using the dictionary of thesaurus in order to enlarge the variation of keywords.

People's preference may change dynamically. However, in this prototype system, the keywords for user's preference are static.

Memorium [7] is a persistent interface like clock. This system provides memos and texts searched by keywords and search engines. People can use it to assist their ideas. Our system is similar to this. However, *Memorium* does not take the ubiquitous display's characteristics or text rendering method into account.

5. Conclusion

We designed and implemented the *AmbientBrowser* system, which can be used from any location and provides Web pages to inform people on a daily basis. It selects target Web pages through various keywords and a Web search engine. It also displays these pages incrementally in relation to inputted parameters. People can read/browse Web pages easily yet efficiently.

We are currently evaluating the effectiveness of our system in field tests. In addition, we are also applying other types of parameters to the *AmbientBrowser* system.

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