Voice Activated Interactive Ambient Information Display

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Abstract—**Normally the primary purpose of an information display is to convey information. If it can be aesthetically interesting, that is an added bonus. Recent research experiments with reversing this imperative. An information display, which is first - aesthetically pleasing and second - is able to display information, is designed and implemented. The display presents an e-mail title in a visual form as a collage of images - each image corresponding to one or more words. It next filters the collage through aesthetic properties specified by an artist, such as colors, texture, and shape. This filter renders the original collage as a pleasing art. We propose an extension of this work by: adding a voice activation module; displaying information of user's request (versus displaying e-mail titles only); and presenting the display in a form of a decorative digital painting hanging on the wall. The advantages of this approach are: being ambient - in a sense of: entering person's attention when needed, and largely disappearing into the environment when not needed; and being interactive - as in providing information per user's interest through speech recognition. This produces new interactive, ambient system for aesthetic information display on user's demand.**

Keywords-**ubiquitous computing, speech recognition, image collage, aesthetic display, human-machine interface.**

I. INTRODUCTION

As computer use has shifted into wider aspects of life, the requirements that it has faced have shifted as well. The value of computing technology was traditionally measured by its results - largely its *usefulness* in solving problems of interest. As computational technology moves beyond the confines of the work environment and into the rest of our lives, we have begun to see an additional requirement emerge: *desirability*. Products such as Apple iMac and iPhone have shown that selling computer technology is starting to be about "nice", and "interesting" and even "beautiful", as well as "understandable" and "easy to use". Our proposed system addresses this trendy *desirability* requirement by its easy to use voice activated information request; and by displaying information in an understandable, pleasing manner, where we use images versus text, and we present them in a form of beautiful art.

Traditionally, we used to think of computers as a glass box, a workstation with keyboard, mouse and monitor sitting on a desk that we seek out when we want to do some work. A shift in thinking, together with technological advances, led to a new generation of user-computer environments including virtual reality; multimedia; as well as pen, eye-movement, and agent-based interfaces; tangible interfaces; and ubiquitous computing. A turn to the "social", "emotional", and "environmental" began shaping the new designs. The trend is towards a ubiquitous computing experience, in which computing devices become so commonplace that we do not distinguish them from the 'normal' physical surroundings. The idea is that a ubiquitous computing device would enter a person's attention when needed, and move to the periphery when not needed, enabling the person to switch calmly and effortlessly between activities without having to figure out how to use a computer to perform a task [1]. In essence, the technology would be unobtrusive and largely disappear into the background.

Weiser [2] marks the birth of ubiquitous computing idea; where, computers would be designed to be part of the environment, embedded in everyday objects, devices, and displays. Today this theme is seen by its research community as the future of computing. Our proposed system taps into this future computing idea, by its design to blend into the the 'normal' physical surroundings, i.e., into the environment.

The rest of the paper is organized as follows: section II. reviews related work, section III. describes our proposed system, and section IV. concludes and discusses directions for the future.

II. RELATED WORK

A. Aesthetic visual displays

Unlike traditional information visualization, ambient information visualizations reside in the environment of the user rather than on the screen of a desktop computer. Currently, most dynamic information that is displayed in public places consists of text and numbers. Skog et al. [3] argue that information visualization can be employed to make such dynamic data more useful and appealing. However, visualizations intended for non-desktop spaces will have to both provide valuable information and present an attractive addition to the environment they must strike a balance between aesthetical appeal and usefulness. Authors implement this idea, with aesthetic filter inspired by the Dutch artist Piet Mondrian, for real-time visualization of bus departure times. The information display is deployed it in a public space.

Lau A. and Vande Moere [4] propose a model, which reveals information aesthetics as the conceptual link between information visualization and visualization art, and includes the fields of social and ambient visualization. Authors model focuses on visualizing large datasets. While information visualization predominantly focuses on effectiveness and functional considerations, it may be neglecting the potentially positive influence of aesthetics on task-oriented measures. Aesthetics has been identified as one of the key problems to be solved in information visualization research [5].

In previous work, Redstrm et al. [6], Holmquist and Skog [7] have been drawing inspiration from famous artists when designing information visualization, creating so-called informative art. By basing visualizations on well-known artistic styles, the hope is to create ambient information visualizations that literally look good enough to hang on the wall, while still providing useful information [3].

In our proposed system, we adopt the information visualization aesthetic filter from Fogarty et al. [8], which is based on the well known Kandinsky [9] artist style.

B. Ambient information displays

Using the physical environment to present information has been explored previously, in particular in ambient media [10]. In ambient media, information displays are designed to present information in the periphery of the users attention. For example, Ishii and Ullmer [10] introduced a lamp that uses different intensity to indicate variations in an information source. Closely related to this is the term calm technology, which was coined to define technology that moves between the periphery and the centre of the users attention [11]. When correctly designed, calm technology should become a natural part of the users everyday surroundings. An example of calm technology was the dangling string, an installation where a hanging piece of wire would shake more or less depending on the traffic in the local network. Many ambient displays have been based on physical constructions, but this puts limitations on the flexibility of the display and the complexity of the information that can be shown. A natural choice would therefore be to use computer graphics for ambient displays. In the past, the cost, size and capabilities of computer screens has been a hindering factor. However, with the rapid advancing of display technologies, they have become more affordable, and therefore it is now possible to hang a high-resolution display on a wall as if it was a poster or a painting. In the future, technologies such as electronic ink and color-changing textiles may make it possible to display computer graphics on almost any surface, even wallpapers or curtains [12]. Several peripheral displays using computer graphics have been presented recently. A common approach seems to be to take information from traditional wall-hung art to inform the design and use of such displays. InfoCanvas are specialized computer displays that provide awareness of some source of information using images, creating a form of virtual paintings [13].

Information collages are automatically generated, aesthetic collection of images in the style of certain artists that reflect dynamic information [8]. Normally the primary purpose of an information display is to convey information. If it can be aesthetically interesting, that is an added bonus. Research by Fogarty [8] experiments with reversing this imperative. An information display, which is first - aesthetically pleasing and second - is able to display information, is designed and implemented. The display presents an e-mail title in a visual form as a collage of images - each image corresponding to one or more words. It next filters the collage through aesthetic properties specified by an artist, such as colors, texture, and shape. This filter renders the original collage as a pleasing art.

C. Voice activated displays

Welch and Bergman [14] propose a voice-operated, interactive message display system designed for inter-vehicle and extra-vehicle communications. The system includes one or more display units having a matrix of light-emitting elements to transmit a message to other vehicles either to the front, rear, side, or combination.

Anderson [15] presents a multifunction in dorm automation system (MIDAS). It is an elaborate automation system featuring web control, voice activation, a security system, with large continuously running information displays. The system was implemented and it functions providing voice activated control for lights, electric blinds, music server, and LED displays. The information on the LED displays is presented in the form of scrolling text.

We are unaware of any previous work on voice activated ambient information display using images, or aesthetic collages.

III. VOICE ACTIVATED AMBIENT INFORMATION DISPLAY

Our proposed system is presented to user as an organic LED display, which blends into the environment. It produces the equivalent of a painting or a poster hanging on the wall in a home or office setting.

The user is then able to walk to it, and say a word or a sentence that he/she would like information about. In the background, the system connects to a search engine, retrieves the titles of the top results, and converts them into images.

It next filters this collage through Kandinsky [9] artist inspired system to represent the images as decorative objects [8]. The user is presented with the requested information in a visual form of beautiful art.

Our proposed method is an extension of the aesthetic information collages system, which we adopt from Fogarty et.al. [8]. We enhance the system by adding a speech
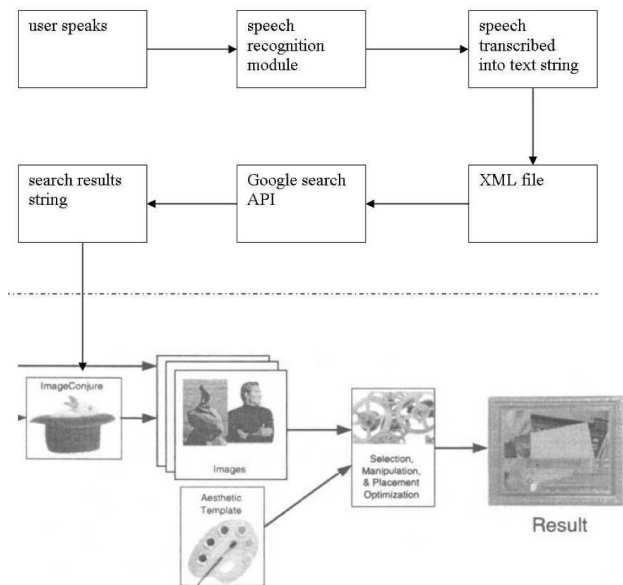
Figure 1.   System diagram of the proposed method.

Figure 2.   Example image collages.

recognition module, a search engine capability for displaying information of user's interest, and we make this system ambient by presenting it in the form of a virtual painting hanging on the wall. It, therefore, blends with the intended environment to be used in.

Our proposed method is illustrated on Figure 1.

A. Speech recognition and search engine connectivity

Our proposed system utilizes the Sphinx speech recognition engines [16] from Carnegie Mellon University, USA. User's speech is transcribed into text.

The text is fed through an XML file into a Google search engine API. We use the Google AJAX Search API, a free web service available through Google Code, which allows us to programmatically search for keywords, and retrieve results. The top search results are retrieved. Each result is saved as a string of words.

B. Image collages and aesthetic filter

A string of textual words is fed to the image collage system. It queries a database of indexed images. The related images are retrieved as a result. This collage of images is likely to reflect the semantic content of the inputted string of words. Example collages are illustrated on Figure 2. The database used is from PhotoDisc Inc. [17] and contains approximately 24,000 royalty-free photos.

Finally, the produced image collage is run through an aesthetic filter based on the well known Kandinsky [9] artist style. Aesthetic templates are the central mechanism for expressing the aesthetic properties. Properties of interest include: color, texture, edges and lines, direction, shape, and
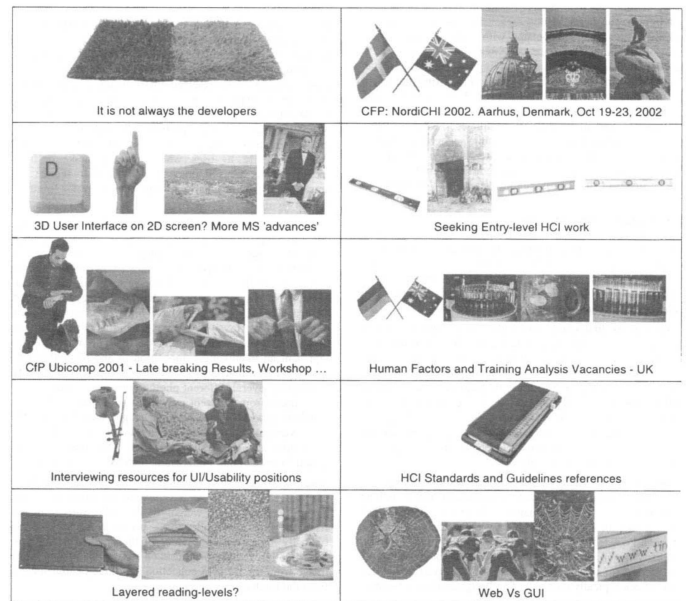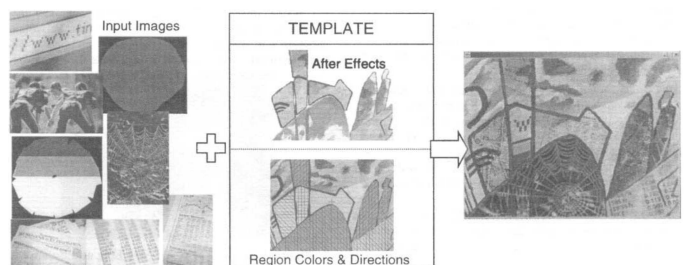

Figure 3.   Example image collages.

relative contrast. An aesthetic template is composed from a layered set of regions [8]. Example image collage, an aesthetic template, and the result are shown on Figure 3.

IV. Conclusion and directions for the future

We produce a novel information display system. It is voice activated through interaction with the user, displays information per user's request, and it blends into the environment. The proposed approach presents an improvement over a previous aesthetic information collage system by creating an interactive ambient information display.

We are unaware of any previous work on voice activated ambient information display using images, or aesthetic collages.

Our proposed system addresses the trendy *desirability* requirement of today's computing. It is easy to use, and it displays information in an understandable, pleasing manner. Our technology is unobtrusive and largely disappears into the background.

To better blend into the environment, this work can be extended by adding a context aware element. An embedded mini camera or a small sensor can be added to the virtual painting, which takes a photo of the surroundings. From the photo context information can be inferred such as: colors of the room walls, of the sunlight, of the person's clothes, and the furnitures. These colors can be used in the aesthetic filter to match the colors shown on the display. Additional information inferred could be the amount of surrounding light - used to adjust the display's brightness; also the shape of the furnitures can be used to match shape of aesthetic elements on the display.

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