

# Messages for Environmental Collaborative Monitoring: The Development of a Multi-sensory Clipart

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**Abstract:** This paper describes the development process of Senses@Clipart, a tool designed to support multi-sensory communication. Senses@Clipart is a library of images, non-spoken sounds and sensory textual descriptions that was developed to be integrated in an environmental monitoring collaborative website. It can be used as a case library to support environmental public participation, offering visual, aural and olfactory views of the environment and of its quality. Sounds, pictorial icons and text are used to annotate photographs in order to highlight objects or their absence. The development of Senses@Clipart has been supported by users' participation both in content production and interface design.

**Keywords:** multi-sensory data, public participation, environmental education, multimedia, clipart, user tests

## 1 Introduction

Public participation within environmental monitoring contributes to increase citizens' involvement and awareness. An example of voluntary monitoring initiatives is the National Audubon Society Christmas Bird Count, which monitors the status of birds' population across the US.

Within voluntary data collection activities colours, shapes, odours and flavours are used by citizens as environmental quality indicators. Although multiple senses are involved in the data collection process, visual indicators prevail. Accordingly, photographs are frequently used as a way to register and communicate the environmental problems observed.

Citizens need tools to explore multi-sensory data allowing them to communicate their findings while drawing other people's attention for specific issues. Furthermore, citizens need educational aids to understand the data they have collected. This paper describes the process of building a library of images, and sensory descriptions, including non-spoken sounds, to support public participation within

environmental monitoring. The development of the Senses@Clipart has been supported by users' participation both in content production and interface design.

## 2 Multi-sensory Messages for Environmental Participation

Human senses are widely used to evaluate environmental quality within voluntary monitoring. However, as environmental sensors, humans are subjective and their accuracy varies according to their individual characteristics (Molhave *et al.*, 1991). Additionally, the combined use of all human senses to evaluate environmental quality requires further research (Camara, 2002).

Multi-sensory approaches to the environment are not traditionally promoted in occidental cultural systems and scientific contexts (Foucault, 1981, Hall, 1989; Schafer, 1994). Formal education plays a major role in this context:

"It has been my experience that after students have spent sixteen or more years in our education system they have been so brainwashed that it is impossible to get them to go out and simply observe and report back what

they heard, what they felt, or what went on before their eyes.” (Hall, 1989, p.39).

“The students became immediately intrigued by these exercises in sensory awareness” (Schafer, 1994, p.13).

Even in environmental education and environmental sciences, that are increasingly integrating multi-sensory approaches, it is difficult to find educational materials to inform the complex task of relating sensory data with environmental quality. The lack of formal experiences and familiarity with multi-sensory messages make it difficult to students and other citizens to produce such kind of messages and to use them in environmental participation.

The use of computer applications, including collaborative systems to present and communicate multidimensional environmental data is reviewed by Camara (2002). Additionally, the emerging mobile communication systems making extensively available digital cameras and multimedia message systems (MMS) create new opportunities for data collection and registration by concerned citizens.

Facing these challenges, a database of multi-sensory messages should be created on the WWW to be used as a “case library” (Hernandez-Serrano and Jonassen, 2002), offering examples of the multitude of views presented on environmental issues. The everyday use of cliparts, although currently with limited multimedia data integration, makes them the appropriate interface metaphor to offer multi-sensory messages. Senses@Clipart is the developed tool that invites, making it easier, to multi-sensory communication. The Senses@Clipart is web based, but it has been thought to be accessed by multimedia mobile phones and interactive TV.

### 3 Senses@Clipart Prototype

The clipart prototype has been developed within the Senses@Watch project (<http://sig.igeo.pt/senses>). This project intends to promote the use of citizen collected data, through the development of collaborative tools designed to facilitate environmental data acquisition, management, visualization and communication. The Senses@Clipart will be integrated in the project collaborative website, which includes data input, access and visualization tools. The Senses@Clipart prototype has been developed with a focus on beach quality monitoring, which is a case study underway Senses@Watch project. Within this case study the Blue Flag criteria (a European eco-label) were used to assess beach quality. In Portugal, beaches are

major areas for recreation and tourism and may present a diversity of coastal problems.

The Senses@Clipart prototype development process included three main phases: 1) exploratory activities to identify users’ needs in terms of multi-sensory messages supporting tools 2) design of a prototype that defines contents and interface of Senses@Clipart and 3) user involvement to test the prototype.

#### 3.1 Exploratory Activities

Two sets of beach exploratory activities were performed previously to the development of Senses@Clipart.

The first exploratory activity (2001) took place at the beach in the context of a natural science class of a teacher’s training school. Ten students, working in pairs, were asked to decide if the beach should have a Blue Flag and to justify their decision, using text and photographs (some cameras were available). Questionnaires, with the Blue Flag criteria, were given to 3 of the 5 pairs. After the activity, students were interviewed about their decisions and opinions. Students did not refer to sounds or smells in their texts and audio interviews. However, sounds and smells were present and represented pollution indicators. From students answers it was also clear that the language used, for example the use of specific terminology used by the Blue Flag criteria, could create errors and misunderstandings. On the other hand, students require some support to use appropriate language to communicate beach quality information. This is even more important concerning sensory data. Activity results illustrated that the use of photos may not be the most appropriate medium to represent the absence of specific attributes, (*e.g.* how can a photo show the absence of litter cans?). This confirms the need to create image annotation tools

A second exploratory activity took place in 2002. Subjects were 15 new students from the mentioned school and class and were asked to explore a different beach and simulate a MMS message to be sent to environmental authorities. As they were asked to refer sounds and smells, as well as to take a picture and write some texts, students produced richer and less homogeneous messages than the subjects of the year before. Students were surprised for being asked to search for sensorial data, but they enjoyed doing it. This second activity confirmed the, already expected, motivation to use multi-sensory messages. The records of this activity also confirmed the need to support the “translation” of sensory data into environmental quality information.

### 3.2 Prototype Design

The clipart design considered a set of concepts, guidelines and examples such as: visual search (Yang *et al.*, 2002), visual representation and meaning (Strothotte, 1998), web photo galleries, image-based hypermedia and clipart organization (Cooper, 1995).

#### 3.2.1 Contents: images, sounds and texts with odours

Since 2001, beach pictures were gathered and added to the clipart after being analysed and classified (*e.g.* by quality indicator). Different sources have been used to gather pictures: 1) project team members' files, 2) coastal experts' files, 3) beach exploration activities with students and 4) web sites including "Viva a Praia" <<http://www.vivapraia.com/>>. The prototype has now around 100 pictures.

A central theme in research about pictures had to do with the two-directional relation between the visual representation of images and their meaning (Strothotte, 1998). In some cases a photorealistic picture may be not sufficient to deliver the intended meaning and may require to work with language. Images represent the visual dimension, but texts can play all the "roles of language", which are everyday used to communicate what is observed by all senses in diverse communication contexts.

Senses@Clipart reserves next to each picture a space for an associated caption and description. The caption specifies the quality indicator referred in the image. The description intends to provide multiple views, namely by describing the picture contents in terms of odours, flavours and textures. The vocabulary was kept simple and focused to be appropriate to the broad range of users.

Besides text, another example of non-pictorial annotation to better convey meaning is the inclusion of non-spoken sounds. Other types of digital annotations were explored in a specific prototype section named Postcards. This section includes multi-sensory messages in which annotations on photos are required to highlight objects and improve communication, for example, a text label or graphic elements such as arrows or icons (Figure 1).



Figure 1: Postcards' details with digital annotations.

#### 3.2.2 Senses@Clipart Interface

The photo gallery approach was selected. In Senses@Clipart the index on the left orients the user inside the information space. The actual version of the menu gives a list of five entries: Blue Flag quality criteria, colours, sounds, smells and postcards. Each entry provides access to specific photo galleries on the right. While navigating through the photo galleries users can also access to sounds (Figure 2).

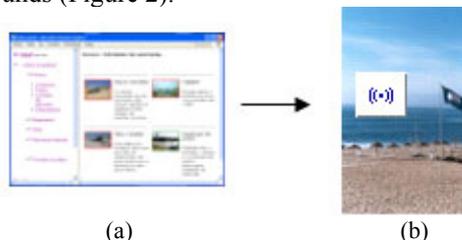


Figure 2: Senses@Clipart prototype. (a) Interface and (b) Photo, showing a Blue Flag Portuguese beach, linked to an ocean sound file.

The design was kept simple and used the Web Component type Photo Gallery of Microsoft FrontPage XP™. Thumbnails were created and used as hyperlinks to full-size version of the photos. Each thumbnail contains an associated caption and description. Highlight should be given to the coloured border added to each thumbnail (green, red or yellow) that indicates the quality tendency of the pictures, following the well known metaphor of beach flags for sea conditions or traffic lights.

#### 3.2.3 User Involvement

The first test was implemented by e-mail and aimed to: 1) validate some Senses@Clipart design choices (*e.g.* photos classification according to the Blue Flag criteria, pictures descriptions) and 2) explore the way people annotate photos to create messages about beach quality. 7 of the 18 subjects sent the answers back. 5 of them were environmental experts and the other two were information technology experts.

Results from this test showed that the design choices of Senses@Clipart were consistent with the subjects' answers. This way, it was decided to maintain the classification of photos according to the Blue Flag criteria and the coloured borders of thumbnails. Some of the texts and pictorial messages created by the subjects are going to be integrated in the clipart. The annotated pictures within the test results confirmed the spontaneous use of circles and arrows to highlight objects or features on photos, but also confirmed the expressive power of other kinds of annotations such as the inclusion of graphics,

icons or text labels. Figure 1 contains two examples of subjects' creativity and work.

In a follow-up test the Senses@Clipart prototype was evaluated with oriented exploration and thinking aloud procedure. Four participants contributed in a volunteer basis. In digital environments thinking aloud is widely used for usability testing (Waes, L.V. 2001). The thinking aloud procedure was used to test the prototype usability regarding: 1) simple searching task (participants should find a picture similar to the one provided) and 2) application task (the participants should focus on knowledge construction aspects such as learning new thematic jargon). The authors were also seeking to identify how the participants could use the prototype to create sensory messages. The session was sound recorded and the observers took notes and photos.

The analysis of prototype usability test allowed to identify menu interaction problems. Changes are being already implemented for further testing.

The results of these tests suggest that users will be able to effectively use Senses@Clipart, learning new concepts useful to evaluate beach quality and to translate sensory data into more accurate environmental quality indicators. User involvement confirmed the options taken considering data contents, classification and interface design.

## 4 Concluding Remarks

The research presented in this paper demonstrates that is useful and possible to implement a simple tool – Senses@Clipart – to support the creation of multi-sensory messages in the context of environmental public participation. Senses@Clipart can be used as case library, making available representative examples of beach quality messages created using sensory monitoring. The use of such tool may contribute to increase citizens' awareness and involvement.

The examples integrated in the prototype are clear and include photos annotated with graphics, icons, texts and non-spoken sounds, as well as short textual descriptions to translate sensory data into environmental quality information.

This research may contribute to develop a broader understanding of the role of multi-sensory communication and interfaces within environmental collaborative monitoring.

Further studies are required to evaluate the use of images, text and sounds to convey data captured by senses like taste and smell. The prototype was structured to accommodate data on beach quality

indicators. In the context of Senses@Watch project, Senses@Clipart should be developed to include a wider range of environmental issues and to be able to incorporate messages sent by citizens when using the project collaborative site.

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