Non Visual Presentation of HTML documents for Disabled and Elderly Using Extended Cascading Style Sheets

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Abstract: The aim of this paper is to propose the expression of the CARE (Complementarity, Assignment, Redundancy, Equivalence) properties for non visual multimodal presentation of electronic documents within the extended Cascading Style Sheet (CSS) formalism.
Firstly the CARE properties and the CSS formalism are briefly described. Then, we present two synchronization and logical operators in order to convey the *Complementarity* and the *Assignment* properties of CARE. Some illustrations are given.

1. INTRODUCTION

Public World-Wide-Web users are accustomed to visual presentation of HTML (Hyper Text Markup Language) documents on a screen. This fact is changing with the development of the distance consultation of emails and HTML pages. So, alternatives to visual presentation are to be found to consult these electronic documents when they are accessed by phone or through an interactive voice server. These alternatives are crucial for the visually impaired persons and elderly persons.
For instance, screen readers based on aural and tactile presentation exist. These screen readers which simply "read" all the characters, use Text-to-Speech systems combined with "sounded" icons (Auditory Icons and/or Earcons) [Gaver 88], [Blattner 89] and/or Braille displays. These solutions lay out on a vocal or a tactile presentation of graphical objects (icons, dialog box, menus, text, etc.). Nevertheless, "presentation rules" are not used.

If many commercial accessibility tools allow blind and print-impaired communities to access electronic documents, they mainly "display" the ASCII text after the filtering of graphic objects and/or the adaptation of the document structure (loss of the spatial organization, for instance). Moreover, some works in the field of cognitive research [Truillet 99] have pointed that the document layout is a sense carrier and seems to increase the comprehension and memorization processes of texts.
Given this current and future importance, it is important to consider all the "dimensions" of an HTML document (the text itself but also all the semantic dimensions such as typographic attributes and the organization).

The goal is to provide blind readers with maximum information (both text and material layout wise) against minimum cognitive effort on their part. The design of a multimodal presentation relies on an effective cooperation between several output modalities. Here cooperation is based on the results of Bernsen's study on output modalities [Bernsen 94] for the representation of information in the acoustic and tactile modes.
Another work used concerns the CARE properties between the interaction techniques that may be available in a multimodal user interface.

We want to study if the CARE properties can be conveyed within the CSS formalism. The CARE properties and the CSS formalism will be briefly described. Then, we present the synchronization and logical operators usable to model the *Complementarity* and the *Assignment* properties.

2. THE CARE PROPERTIES WITHIN THE CSS FORMALISM

2.1. The CARE Properties

CARE was defined as a formal framework to characterize and to assess the relations between several modalities. These relations concern: the *Complementarity, Assignment, Redundancy and Equivalence* between modalities which may be used sequentially, concurrently, independently or combined synergistically [Nigay 93]. The CARE properties [Coutaz 95] rely on the notions of modality and temporal relationships. Several works have mainly studied this expression tool for input modalities [Catanis 95], [Zanello 97].
In [Truillet 97b, 99], the CARE properties were used as a toolkit to design multimodal presentation systems of HTML documents.

2.2. The CSS formalism

The World Wide Web Consortium [W3C 98a, c] proposed the Cascading Style Sheet (CSS) formalism. Our work hypothesis is that this formalism is supposed to be flexible and adaptable for information presentation strategies. Then, the goal of this work is to demonstrate that it is possible to associate multimodal presentation to the interactive objects by using the CSS formalism.
Using Cascading Style Sheets rather than HTML tags extensions allows the same documents to be read with visual (on a screen), aural (with Text-To-Speech (TTS) systems), tactile (with Braille displays) or multimodal presentation without having to produce several forms of documents.
In this way, the HTML document representation and the document presentation are independent. This approach could provide improved accessibility of document for disabled people without compromising the visual design of the document.

The Figure 1a shows how the CSS specifies the presentation (Figure 1b) by assigning values to style properties.

```
<HTML>
<HEAD>
<STYLE TYPE="text/css">
<!--
H1
 {
  color: #008000;
  margin-left: 4%;
  font-family: Comic Sans MS, helvetica, sans-serif;
  font-size: 16pt;
 }
-->
```

Tag

Typographic attributes

```
</STYLE>
</HEAD>
<BODY BGCOLOR="FFFFFF">
<H1>Example with CSS</H1>
</BODY>
</HTML>
```

Figure 1a: CCS example.

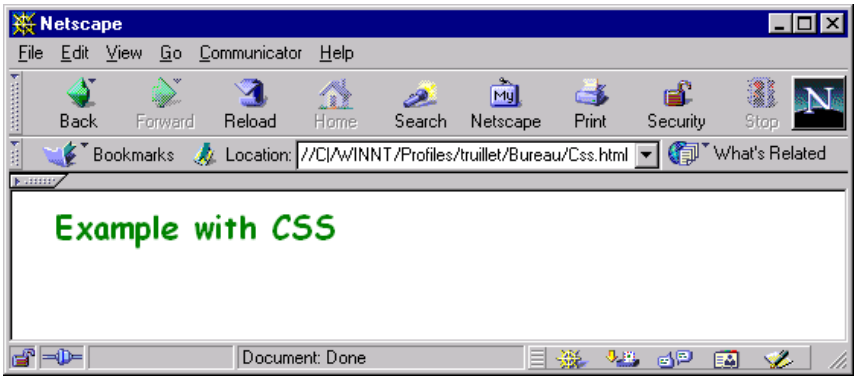

Figure 1b: Visual presentation of the description given in the Figure 1a.

Here, the visual presentation of the H1 tag is green colored, 4 inches margin-left and "Comic Sans MS" font is used.

T.V. Raman [W3C 97] proposed an extension of the CSS model for an aural presentation (***A**ural **C**ascading **S**tyle **S**heet*) by adding audio properties (*volume, pause, play*), spatial properties (*angle, elevation*) to play a 3D sound and TTS properties (*pitch, speed, voice-family*). These properties were integrated in the CSS level 2 working draft [W3C b].

2.3. CARE properties in CSS formalism

The aim of this paper is to evaluate the capabilities of the CSS formalism and its expressiveness to allow multimodal presentation. Our goal is to extend the possibilities of the CSS formalism to take into account the multimodal cooperation between tactile and aural modalities.

Assignment and *Redundancy* properties can be easily modeled in the CSS formalism as shown in Figure 2.

```
<HTML>
<HEAD>
<STYLE>
<!--
@media print, screen
 {
  H1
   {
    color: #008000;
    margin-left: 4%;
    font-family: Comic Sans MS, helvetica, sans-serif;
    font-size: 16pt;
   }
 }

@media aural
 {
  H1
   {
```

To express the Redundancy, we list the different media.

```
    cue-before: url("ding.wav");
    voice-family: robert;
    pitch: low;
    speech-rate: slow;
   }
 }
-->
</STYLE>
<LINK rel= "stylesheet" type="text/css" media= "screen, aural">
</HEAD>
<BODY>
. . .
</BODY>
</HTML>
```

This description conveys the Assignment property.

Assignment of output media

Figure 2: Model of the Redundancy property.

As shown in Figure 2, CSS defines presentation property classes associated on both HTML tags and media. The `@media` rule allows to extend the HTML document presentation to other media (Cf. Figure 3.).

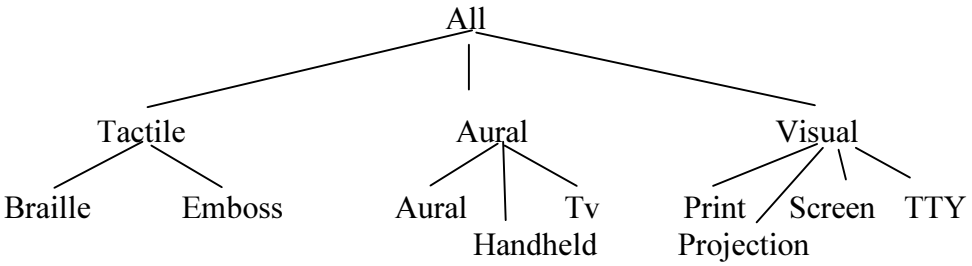

Figure 3: Media types defined within the CSS formalism [W3C 97].

For each used media, CSS specifies a possible presentation. User can modify each property on line regarding its capabilities [RNIB 98]. Nevertheless, problems still occur in order to model cooperation between modalities.

First, the *Complementarity* property is not modeled. For instance, a CSS does not allow to present typographic information on a Braille display and synthesize the information associated on a Text-to-Speech synthesis system.
Then, the definition of the media used and its properties have to be refined and structured. For instance, the "*aural*" medium groups properties for both verbal (recorder speech, Text-to-Speech) and non-verbal (Auditory Icons, Earcons) modalities.
It will be more easy to model modalities uses than media uses.
Moreover, we have to extend the cooperation concept between modalities (in the CARE meaning) because there is no rule to model them.
Finally, temporal properties (use of several media in sequence or in parallel) are just defined in a global level. We have to refine these for each tag of the document.

3. THE EXTENSION OF THE CSS FORMALISM

Firstly, we refined the different media into the modality classes as illustrated in the Figure 4.

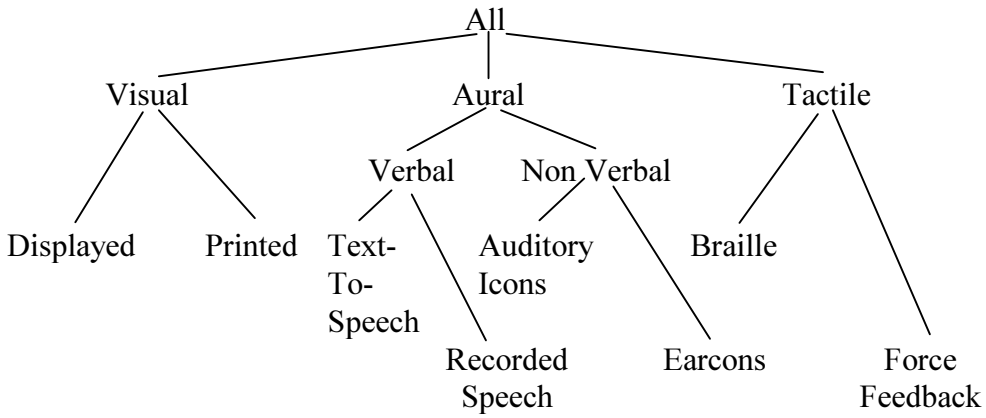

Figure 4: Modality types in the CSS formalism.

One major criterion is to stay independent of the device used. Three classes of modalities have been defined: *visual*, *aural* and *tactile*. Each class can be decomposed in several sub-classes of modalities. This proposition is not limited only to these modalities: this model can be extended to other presentation modalities.

A style is defined by its properties (for instance, size of characters for a visual presentation). This definition can be made:

- for the whole modalities,
- for each modality.

```
H1
 {
  meaning: Header 1
  // Text-to-Speech presentation
  @modality TTS:
   {
    voice-family: robert;
    pitch: low;
   }

  @modality screen:
   {
    font : Comic Sans MS;
   }
 }

  @modality braille:
   {
   }
}
```

global property (for all modalities).

specific properties (for each modality).

Figure 5: For each style, specification of the presentation.

The presentation rules are not specified necessarily even if the presentation properties have been defined. For example, how a Title (`H1`) has to be presented both to Braille display and aurally?
In consequence, we added some operators in CSS like:

1. synchronization operators between modalities; two operators were added: *parallel* noted **#** or *sequential* noted **;**. Note that synchronization and buffer-size harmonization between the Braille display and the TTS system are not easy to achieve,
2. binary operators for multimodal cooperation ("*and*" noted **&&** for synergy and "*or*" noted **||** for independence)

3. and another operator for user's preferences. This operator is defined by the order of presentation rules.

Moreover, for each used style, the presentation rules can also be refined.

In this formalism, a redundant presentation (in the CARE meaning) of a title for TTS and Braille modality is written (cf. Figure 6):

```
#(@TTS.H1 && @braille.H1)
```

Figure 6: Redundancy property for "Title" style.

User's preferences can be formalized by means of a decreasing interest list of presentation modalities as follow:

```
@braille.H1 || @TTS.H1 || @Recorded_Speech.H1
```

Figure 7: Presentation preference for "Title" style within the CSS formalism.

For example (Cf. Figure 7), the Braille modality is used firstly. By default, the TTS modality will be used and by default, recorded speech will be used.
Moreover, these preferences can be specified for each typographic attribute of the electronic document (title, bold, italic, etc.).

In this formalism, *Equivalence* is written like this:

```
@TTS.H1 || #(@braille.H1 && @Recorded_Speech.H1)
```

Figure 8: An Equivalence model.

In this example, in order to present "H1" style, Text-To-Speech synthesis will be used. By default, a cooperation between Braille and recorded speech will be used. This cooperation is supposed to be equivalent to TTS presentation.

The *Complementarity* property can be written as follow:

```
;(@braille.H1.style && @TTS.H1.text)
```

Figure 9: Complementary property within the CSS formalism and its extension.

The "Title" style is restituted by two modalities: Braille and TTS. Braille modality displays the style (e.g. "Title") and TTS synthesis modality the ASCII text in relation with the style.

4. CONCLUSION

The rewriting of CARE properties within the CSS formalism has been illustrated and has been demonstrated for multimodal presentation based on aural and tactile modalities. To permit the complementary and assignation properties, synchronization and logic operators were added. The implementation of this formalism is in progress within the Smart-Net project [Truillet 97].

An input interface is also in progress to allow inexperienced or novice users to define its presentation characteristics. After these two steps, each potential user will have the possibility to personalize the presentation style of electronic documents in regard to its behavior and

perceptual model. The CARE properties and the CSS formalism are two complementary tools usable for the design of multimodal interface.

5. REFERENCES

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