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Source:	**Weight DS Core Experiment partecipants**
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1 Introduction

In this document, we report the result of our core experiment on the Weight DS. In the last meeting a decision is made to continue the Weight DS CE in order to address:
- an improvement of the Weight DS syntax which is currently part of the XM document
- to demonstrate the benefit to have such component as a basic datatype to provide a large variety of functionalities for various DS
- to accomodate for required MPEG-7 functionalities (such as ordering) [1], for specific DS's (e.g., Segment DS, Semantic DS components).

2 Outline of CE activity

2.1 Participants and functionalities to be validated

The main activities and the participants are summarized in the below table

Name	Company	Functionality
Yoshiaki Shibata	Sony	Definition of new sintax of Weight DS
Kyoungro Yoon	LG CIT	Definition of new sintax of Weight DS and usage of Weight DS to identify segments (video segments) which represents objects defined in the Object DS
Alessandro Bugatti, Riccardo Leonardi	University of Brescia	Definition of new syntax of Weight DS, istantiation of Weight DS for ordering functionality and realization of two demos in order to demonstrate ordering functionalities
Benoit Mory	Philips	Cross-check of results of Brescia experiments

2.2 Methodology

For the three main parts of the CE the following strategies has been used:
- the new Weight DS syntax definition is based on that included in MDS XM 3.0 and an agreement has been achieved in order to obtain both representation functionalities (see paragraph …) and ordering keys functionalities (see paragraph …)
- an instantion of the Weight DS was built to demostrate its utility to obtain a measure of how well each segment (video segment) represents a selected object by a weight value
- two demos were built to show ordering keys functionalities. For each demo there is an XML file MDS compliant validated by XML 3.0 Spy

3 Experimental results

3.1 New syntax of Weight DS

3.1.1 Syntax and semantics definition of the Weight DS

The Weight DS syntax contained in MDS XM 3.0 was improved in order to obtain both generic weighting functionalities and ordering functionalities.

```
<!-- ############################################# -->
<!--      Weight DS as a basic element            -->
```

```xml
<!-- ############################################### -->
<!--Improved Weight DS definition based on MDS XM 3.0-->

<!--Definition of ReliabilityType-->

<simpleType name="ReliabilityType" base="decimal">
      <minInclusive value="0.0"/>
      <maxInclusive value="1.0"/>
</simpleType>

<!--Definition of WeightValueType-->

<simpleType name="WeightValueType" base="float">
      <minInclusive value="0.0"/>
      <maxInclusive value="1.0"/>
</simpleType>

<!--Definition of WeightValue-->

<complexType name="WeightValue">
      <attribute name="Value" type="mpeg7:WeightValueType"/>
      <attribute name="idref" type="IDREF" use="optional"/>
</complexType>

<!--Definition of DescriptorReference-->

<!-- Note: the DescriptorReference allows to indicate a Descriptor or a
Description scheme. At the moment is not clear which method should be
used to obtain this functionality (XPointer, an abstract class for each
D or DS,...). Further discussion is needed-->

<complexType name="DescriptorReference" base="mpeg7:Descriptor"
derivedBy="extension">
   <attribute name="Reliability" type="mpeg7:ReliabilityType"
use="optional"/>
</complexType>

<!--Definition of ReferencedWeight-->

<complexType name="ReferencedWeight">
   <element name="DescriptorReference"
type="mpeg7:DescriptorReference"/>
      <attribute name="idref" type="IDREF" use="optional"/>
<!--At the moment the Value usage is not clear, so futher discussion is
needed-->
      <attribute name="Value" type="mpeg7:WeightValueType"
use="optional"/>
</complexType>

<!--Definition of Weight DS-->

<complexType name="Weight">
      <choice>
            <element name="WeightValue" type="mpeg7:WeightValue"
minOccurs="1" maxOccurs="unbounded"/>
            <element name="ReferenceWeight"
type="mpeg7:ReferencedWeight" minOccurs="1" maxOccurs="unbounded"/>
```

```
        </choice>
        <attribute name="id" type="ID"/>
        <attribute name="Reliability" type="mpeg7:ReliabilityType"
use="optional"/>
        <attribute name="WeightName" type="string" use="optional"/>
</complexType>
```

where the semantic of each component is summarized as

Semantics of the datatypes:

Name	Definition
ReliabilityType	Datatype of the reliability value defined within 0.0 and 1.0 where 1.0 for the most reliable while 0.0 for the least (no reliable).
WeightValueType	Datatype of the weighting value defined within 0.0 and 1.0 where 1.0 for the most important while 0.0 for the least.

Semantics of WeightValue:

Name	Definition
WeightValue	Type of primitive weight element in this scheme. It allows an association of a weight to an instance of description scheme by idref.
Value	The weigh value assigned to the component.
idref	Id reference to the target entity to be weighted. This component can be omitted when the weighting value is assigned as a nested form.

Semantics of ReferencedWeight :

Name	Definition
ReferencedWeight	Type of primitive weight element in this scheme. It allows to indicate which descriptor/s can be useful for ordering functionalities.
DescriptorReference	Reference to a Descriptor class. NOTE: At the moment it is not clear which method should be used to implementate this funcionality (Xpointer, Xpath, ….).
DescriptionReliability	Element to specify the reliability that is associated with the specific descriptor (it is a 'local' reliability, different from the global reliability which is included at Weight level)
Value	The weigh value assigned to the component. NOTE: Its utility is not so clear, but its insertion in this scheme could address new functionalities in the future
idref	Reference to an instance of a description scheme. Each node child of the referenced node can be ordered using the referenced Descriptor. It is optional because its use is only required in schemes which don't contain a Weight DS in their sintax, while it is not needed in schemes which include Weight DS

Semantics of Weight DS

Name	Definition
Weight	Standard weight element in this scheme.
WeightName	The semantics of the reference value. This value specifies how to interpret the weight value.
WeightValue	Primitive element to associate a weight to an instance of description scheme by idref
ReferencedWeight	Primitive element to indicate which descriptor/s can be useful for

	ordering functionalities.
id	Identifier for each instance of the Weight DS.
Reliability	Describes how reliable the weights are. In other words, it is a confidence measure of the weights. For example, if the reliability is low, the weight value is not trustworthy; on the other hand, if the reliability is high, the weight value represents the importance of the target description very well. The range of this value is 0.0 to 1.0.

3.1.2 Description extraction

The Weight DS can be used in any kinds of entity weighting and thus its description extraction is up to applications, where either automatic or manual extraction or both may be used.

3.1.3 Description examples

The Weight DS defined above supports any weighting description forms. In the following description examples, we show both generic functionalities and ordering functionalities, in nested form (when the Weight DS can be contained in a Description Scheme) and in top level form (when the Weight is used as top-level element). In order yo validate these examples an MPEG-7-Root has been defined and some names have been changed, but these changes do not appear in the below examples in order to be clearer.

Example 1: using only the generic weighting functionality in nested form

```
<?xml version="1.0" encoding="UTF-8"?>
<MPEG-7-Root xmlns="http://www.mpeg7.org/2001/MPEG-7_Schema"
xmlns:xsi="http://www.w3.org/1999/XMLSchema-instance"
xsi:schemaLocation="http://www.mpeg7.org/2001/MPEG-7_Schema
C:\users\Bugatti\UPMSAnnotator\mds4CE.xsd">
<Concept id="id1" name="Fruit">
   <ConceptObject id="id2" name="Apple">
     <Weight>
        <WeightValue Value="0.765">
     </Weight>
   </ConceptObject>
   <ConceptObject id="id3" name="Banana">
     <Weight>
        <WeightValue Value="1.235"/>
     </Weight>
   </ConceptObject>
</Concept>
</MPEG-7-Root>
```

In this case it is possible to associate a weight to each ConceptObject (Apple and Banana) in nested form because ConceptObject contains the Weight DS in itself.

Example 2: using only the weighting functionality in referenced from

```
<?xml version="1.0" encoding="UTF-8"?>
<MPEG-7-Root xmlns="http://www.mpeg7.org/2001/MPEG-7_Schema"
xmlns:xsi="http://www.w3.org/1999/XMLSchema-instance"
xsi:schemaLocation="http://www.mpeg7.org/2001/MPEG-7_Schema
C:\users\Bugatti\UPMSAnnotator\mds4CE.xsd">
```

```
<VideoSegment id="id1">
    <SegmentDecomposition DecompositionType="temporal">
       <VideoSegment id="id2">
          <MediaTime>
             <MediaTimePoint/>
          </MediaTime>
       </VideoSegment>
       <VideoSegment id="id3">
          <MediaTime>
             <MediaTimePoint/>
          </MediaTime>
       </VideoSegment>
    </SegmentDecomposition>
    <MediaTime>
       <MediaTimePoint/>
    </MediaTime>
</VideoSegment>

<Weight id="id4" Reliability="0.8">
   <WeightValue idref="id2" Value="0.5">
   <WeightValue idref="id3" Value="0.2">
</Weight>
</MPEG-7-Root>
```

In this case it is possible to associate a weight to video segments (id2 and id3), which don't contain the Weight DS, by idref attribute.

Example 3: using the nested form to allow to choose an Descriptor or Description Scheme to obtain ordering functionalities

```
<?xml version="1.0" encoding="UTF-8"?>
<MPEG-7-Root xmlns="http://www.mpeg7.org/2001/MPEG-7_Schema"
xmlns:xsi="http://www.w3.org/1999/XMLSchema-instance"
xsi:schemaLocation="http://www.mpeg7.org/2001/MPEG-7_Schema
C:\users\Bugatti\UPMSAnnotator\mds4CE.xsd">

<Concept id="id1" name="Fruit">
   <Weight>
     <ReferencedWeight>
        <DescriptorReference>ColorHistogram</DescriptorReference>
     </ReferencedWeight>
   </Weight>
   <ConceptObject id="id2" name="Apple">
   <MediaModel SemanticLabel="Apple" Confidence="0.9">
         <MediaLocator>
            <MediaURL>c:/apple.jpg</MediaURL>
         </MediaLocator>
   </MediaModel>
   <Example SemanticLabel="Apple" NumElements="1" Confidence="0.8"
DescriptorName="ColorHistogram">
     <Descriptor>
     4617 11986 938 2628 458 1463 5178 2258 444 134 69 456 9300 2810
     121 21 14 18 48 107 277 53 47 1926 8281 793 38 11 0 5 201 28 0
     1 1 2 23 252 122 6 3 433 1517 46 1 1 0 0 0 0 0 0 0 2 55 13560
     3326 678 221 1610 5602 916 32 8 1 21 58 11 1 0 0 2 61 331 179
     14 7 2388 6213 51 0 0 0 0 0 0 0 0 0 0 0 2 337 243 0 0 220 194 0 0
```

```
          0 0 0 0 0 0 0 0 0 0 383 3172 1072 51 20 91 128 0 0 0 0 0 2 4 0
          0 0 0 89 757 694 0 0 217 39 0 0 0 0 0 0 0 0 0 0 0 0 912 210 0 0
          0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 55
       </Descriptor>
    </Example>
  </ConceptObject>
  <ConceptObject id="id3" name="Banana">
  <MediaModel SemanticLabel="Banana" Confidence="0.9">
         <MediaLocator>
            <MediaURL>c:/banana.jpg</MediaURL>
         </MediaLocator>
  </MediaModel>
  <Example SemanticLabel="Banana" NumElements="1" Confidence="0.7"
DescriptorName="ColorHistogram">
     <Descriptor>
     1764 18807 725 816 553 1784 7133 1325 81 3 8 110 5621 2323 34
     11 0 3 12 82 156 26 11 700 3060 63 7 0 0 0 1 0 0 1 0 0 16 95 40
     4 0 16 20 1 0 0 0 0 0 0 0 0 0 0 0 17 13534 3211 523 126 1123
     5181 347 37 0 0 0 5 8 2 1 0 2 17 261 168 3 0 997 2635 3 0 0 0 0
     0 0 0 0 0 0 2 292 39 0 0 17 1 0 0 0 0 0 0 0 0 0 0 0 0 157 861
     430 3 0 26 14 0 0 0 0 0 0 0 0 0 0 0 21 608 215 0 0 81 1 0 0 0 0
     0 0 0 0 0 0 0 0 373 37 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 9
     </Descriptor>
  </Example>
</ConceptObject>
</Concept>
</MPEG-7-Root>
```

In this case the object id1 (fruit) contains a weight DS which is used to point at a Descriptor (ColorHistogram). This Descriptor can be used to the application for ordering the children nodes (apple and banana).

Example 4: using the referenced form to allow to indicate a Descriptor or Description Scheme to obtain ordering functionalities

```
<?xml version="1.0" encoding="UTF-8"?>
<MPEG-7-Root xmlns="http://www.mpeg7.org/2001/MPEG-7_Schema"
xmlns:xsi="http://www.w3.org/1999/XMLSchema-instance"
xsi:schemaLocation="http://www.mpeg7.org/2001/MPEG-7_Schema
C:\users\Bugatti\UPMSAnnotator\mds4CE.xsd">

<VideoSegment id="id1">
    <SegmentDecomposition DecompositionType="temporal">
       <VideoSegment id="id2">
          <MediaTime>
            <MediaTimePoint/>
          </MediaTime>
          <CameraMotion NumSegmentDescription="3" DescriptionMode="1">
            <CameraMotionSegment>
              <FractionalPresence>
                <TRACK_LEFT_F>0.23</TRACK_LEFT_F>
                <ZOOM_IN_F>0.56</ZOOM_IN_F>
              </FractionalPresence>
              <Amount/>
            </CameraMotionSegment>
          </CameraMotion>
       </VideoSegment>
```

```xml
        <VideoSegment id="id3">
           <MediaTime>
              <MediaTimePoint/>
           </MediaTime>
           <CameraMotion NumSegmentDescription="3" DescriptionMode="1">
              <CameraMotionSegment>
                 <FractionalPresence>
                    <TRACK_LEFT_F>0.1</TRACK_LEFT_F>
                    <ZOOM_IN_F>0.8</ZOOM_IN_F>
                 </FractionalPresence>
                 <Amount/>
              </CameraMotionSegment>
           </CameraMotion>
        </VideoSegment>
        <VideoSegment id="id4">
           <MediaTime>
              <MediaTimePoint/>
           </MediaTime>
           <CameraMotion NumSegmentDescription="3" DescriptionMode="1">
              <CameraMotionSegment>
                 <FractionalPresence>
                    <TRACK_LEFT_F>0.67</TRACK_LEFT_F>
                 </FractionalPresence>
                 <Amount/>
              </CameraMotionSegment>
           </CameraMotion>
        </VideoSegment>

     </SegmentDecomposition>
     <MediaTime>
        <MediaTimePoint/>
     </MediaTime>
</VideoSegment2>

<Weight id="id5" Reliability="0.8">
   <WeightName>Action</WeightName>
   <ReferencedWeight idref="id1">
      <DescriptorReference>TRACK_LEFT_F</DescriptorReference>
   </ReferencedWeight>
</Weight>

<Weight id="id6" Reliability="0.5">
   <WeightName>Interesting</WeightName>
   <ReferencedWeight idref="id1">
      <DescriptorReference>TRACK_LEFT_F</DescriptorReference>
      <DescriptorReference>ZOOM_IN_F</DescriptorReference>
   </ReferencedWeight>
</Weight>

</MPEG-7-Root>
```

In this case the Description Scheme (VideoSegment) doesn't contain the weight DS, so it is not possible to use the nested form as in example 3, but the idref is needed to point at the parent node. In weight DS id="id5" the referenced node is the video segment id1 and so its children (video segments id2, id3 and id4) can be ordered using the TRACK_LEFT_F descriptor. The label "Action" indicates the semantic of this ordering. The other weight id="id6" points at the same parent node (video segment id1) and so its child

(video segments id2, id3 and id4) can be ordered using the TRACK_LEFT_F and ZOOM_IN_F descriptor. If a child (in this example id4) doesn't contain a descriptor (ZOOM_IN_F), it is can't be ordered with this weight.

3.1.4   Validation experiments

In the following paragraphes two experiments are shown, one for generic weighting functionalities and one for ordering functionalities.

3.2   Experiment 1: Weight DS usage to obtain how well a Segment represents a Semantic Object

The context of this part of CE is to identify segments (video segments) which represents objects defined in the Object DS. How well each segment represents the selected object is represented by the Weight Value (in the GoodnessOfRepresentation). In this way, users can easily locate the segments relevant to the Object (semantic element, in general) in the sorted order based on the Weight Value. The extraction methods of the Weight Value can be various and one example of the extraction and measure can be the relative size of the object in the Frame (or Group of Frames).

A new definition of SegmentSemanticLink DS is used in order to allows links beetween a segment and a Object. This definition is the following:

```xml
<!-- ############################################## -->
<!-- Definition of "SegmentSemanticLink DS"          -->
<!-- ############################################## -->

<complexType name="ReferenceToSegment" base="mds:Reference"
derivedBy="restriction">
     <attribute name="href" type="uriReference" use="optional"/>
     <!--attribute name="idref" type="IDREF" refType="Segment"
use="optional"/-->
     <attribute name="idref" type="IDREF" use="optional"/>
</complexType>

<complexType name="SegmentNode">
     <element name="ReferenceToSegment" type="mds:ReferenceToSegment"/>
     <element name="GoodnessOfRepresentation" type="mds:Weight"
minOccurs="0" maxOccurs="1"/>
</complexType>

<complexType name="SegmentSemanticLink">
     <element name="ReferenceToSemanticElement"
type="mds:ReferenceToSemanticElement"/>
     <element name="SegmentNodes" type="mds:SegmentNode"
maxOccurs="unbounded"/>
     <attribute name="id" type="ID" use="optional"/>
</complexType>
```

A schema file (testSchema.xml) and an instantiation of Weight DS (WeightCEFinal.xml) are attached at this document and both were validated using XML Spy 3.0. Only the relevant parts (Video Segment DS, partial Object DS and SegmentSemanticLink DS) are specified and instantiated. The Video Segment DS definition was changed in order to achieve validation.

3.3 Experiment 2: ordering functionalities

Two demos were built to show ordering key functionalities and instantiations of these two examples are contained in files VideoSegment.xml and Fruit.xml. Both the files was validated using XML Spy 3.0 and a MDS WD and XM schema from Yoshiaki with adds in order to validate the above examples (mds4CEnew.xsd).

In the first one we used a pre-existing structure (in terms of programs, scenes and shots decomposition) and we translated it in MDS XML form with also the ordering functionalities.
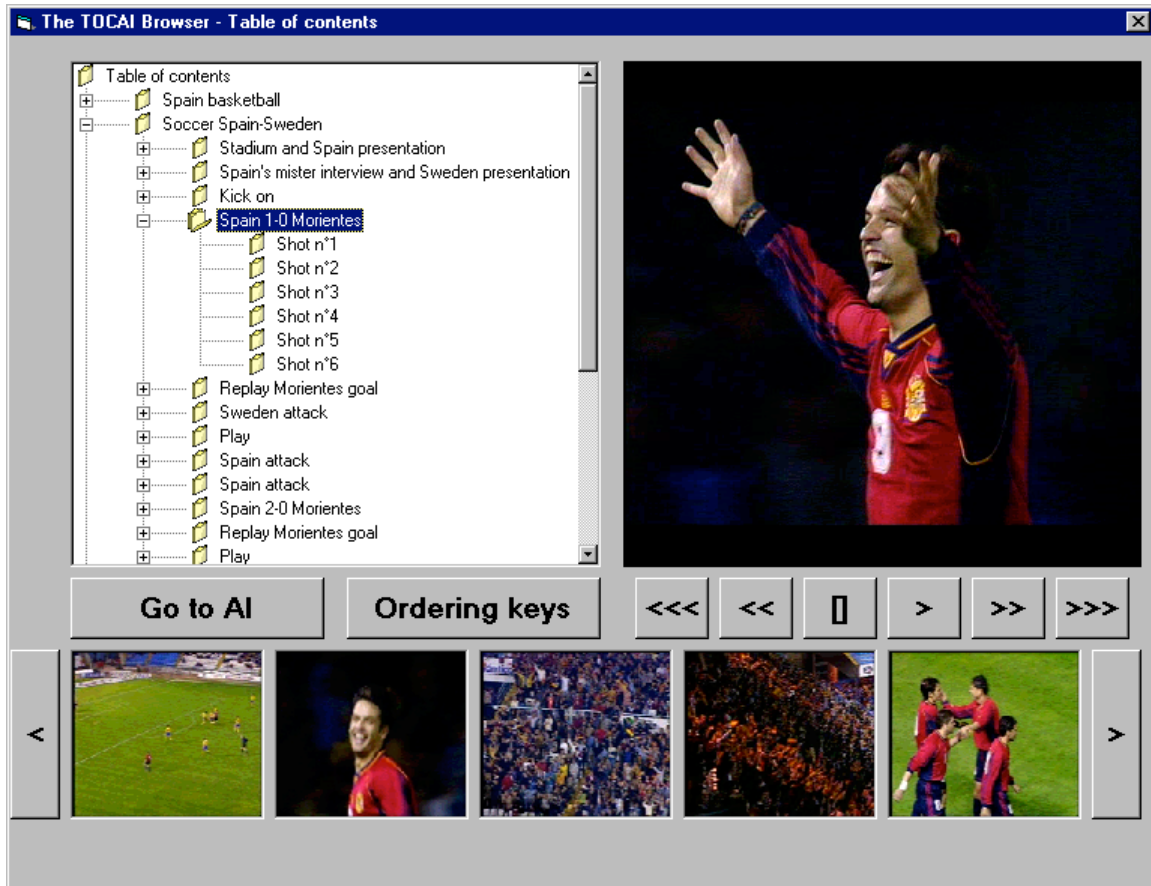
Figure 1 - In the left panel there is the segmented structure (programs, scenes, shots) and a scene (Spain 1-0 Morientes) is selected. By Ordering keys button click is possible to select one Ordering key (in this case Pan Speed) and to obtain the following result
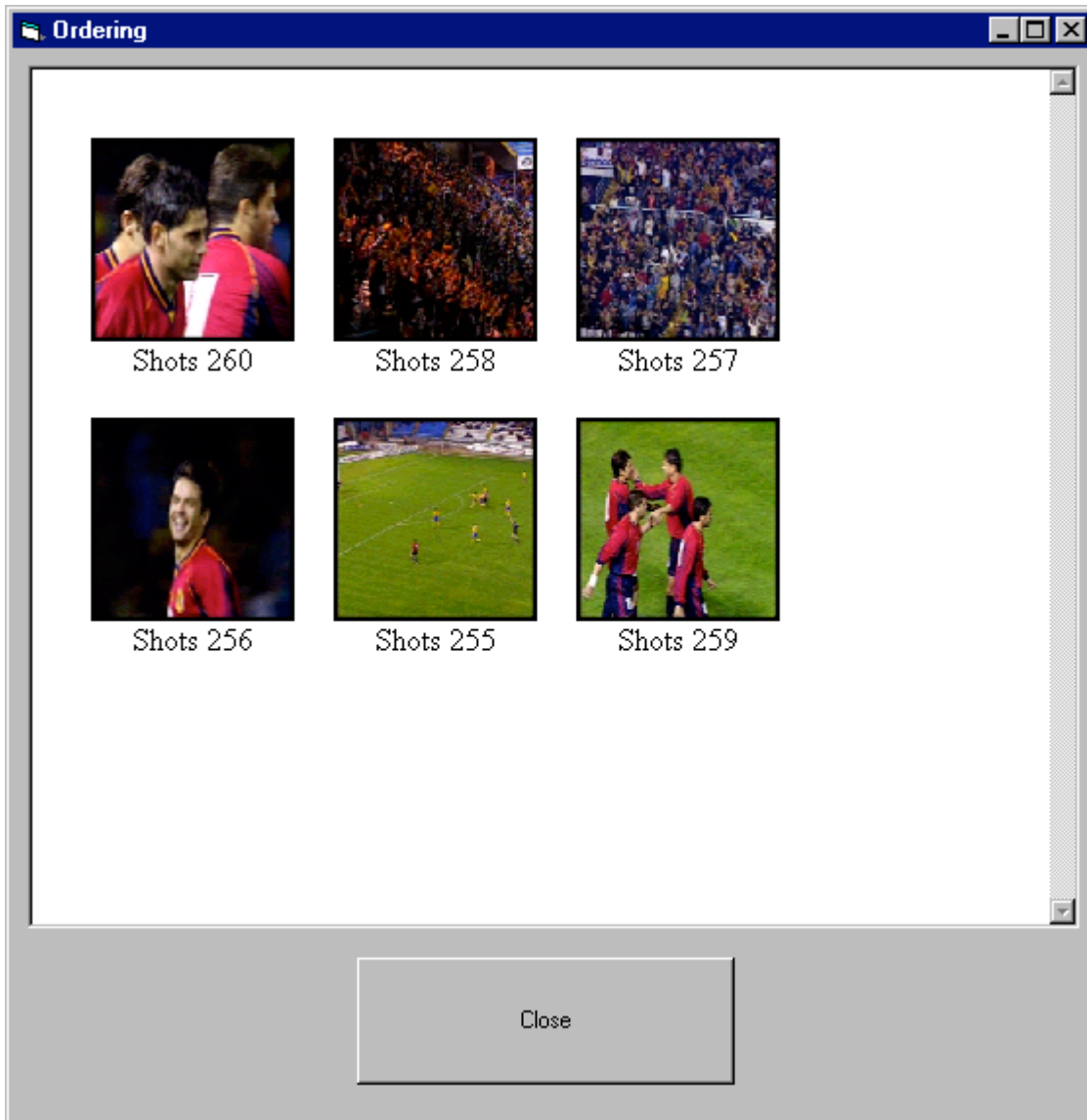
Figure 2 - The shots contained in scene "Spain 1-0 Morientes" are ordered by Pan speed ordering key

In the second one the same results are achieved, but the example use the Concept DS and Concept Object DS to describe a classification of fruit.
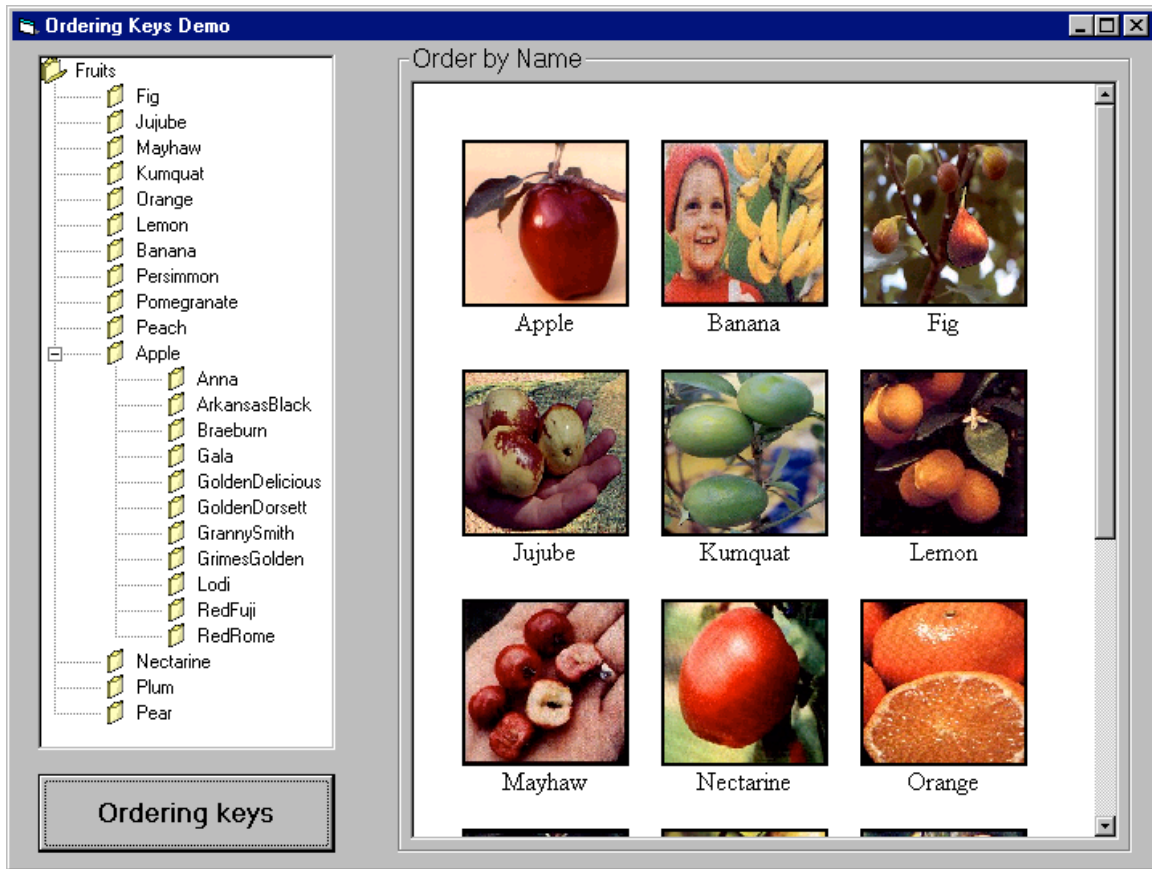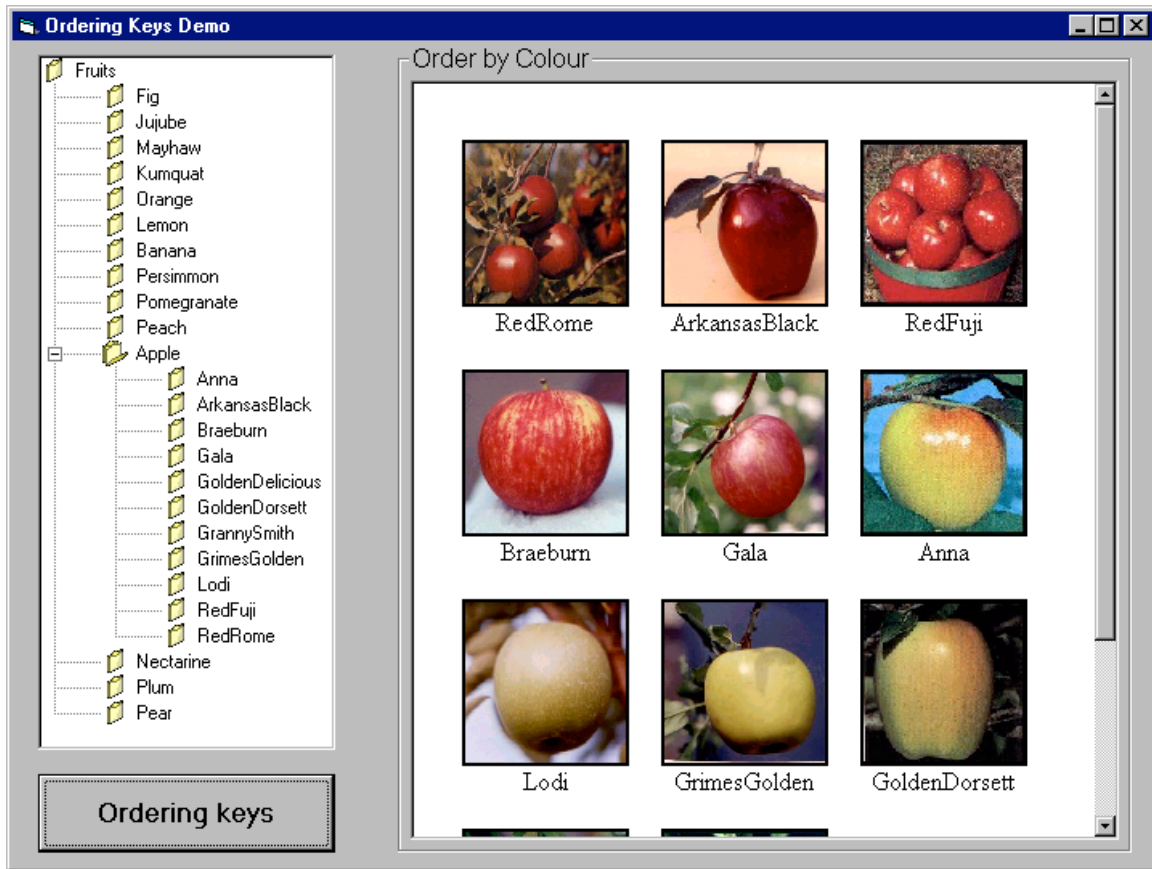
Figure 3 - Fruits are ordered by name

Figure 4 - Varieties of apple are ordered by their colour

4   Conclusions and recommendations

We have demonstrated that this new syntax of Weight DS can support both generic functionalities and ordering functionalities. For both a nested form (when the Weight DS is included in DS) and a referenced form (when the Weight is used as top level element) are possible.

We recommend a further discussion about the possiblity to indicate a D or a DS and to verify if Xpath is proper to achieve this aim.

5   References

[N2996] ISO/IEC JTC1/SC29/WG11/N2996, MPEG-7 Requirement document, v.10, F. Pereira, Melbourne, Oct., 1999