The QDF file format: an electronic system to describe ancient andean khipus

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Abstract

With the goal of bringing to researchers of the ancient andean khipus with a tool to share and process electronically the current corpus of these ancient information devices, I present on this paper a proposal for a Quipu Description Format QDF, a XML based file format designed to describe such documents in a systematic and computer standard way.

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1 Introduction

The fashion of the ancient Andean khipus are astonishing similar to the data structures found in the modern computers. Basically, a khipu is composed of a main cord where subordinated cords with knots are attached, following a hierarchical order, very similar as the layout of directories and files present on a computer filesystem. We can take advantage of this similarity to design a file format to describe electronically these ancient documents.

Currently the computer science brings us a very useful tool to make such description. This is the Extensible Markup Language (XML). It is a W3C-recommended general-purpose markup language for creating special-purpose markup languages. It is a simplified subset of SGML, capable of describing many different kinds of data. Its primary purpose is to facilitate the sharing of data across different systems, particularly systems connected via the Internet (Wikipedia, 2005).

Using the principles of XML, a markup language to describe khipus can be easily designed, bringing the possibility to store those descriptions in a standard way allowing its sharing and processing easily for software packages built upon widely available XML processing libraries as is LibXML2 or Expat.

This paper will describe a proposal for such a format, denominated Quipu Description Format (QDF), version 0.2.

2 QDF Structure.

Being a format based in the XML specification, the first lines to be present in a khipu description file must be:

```xml
<?xml version="1.0"?>
<!DOCTYPE quipu SYSTEM "qdf.dtd">
</quipu>
```

These lines indicate to any XML parser the document type (quipu) and the Document Type Definition (DTD) which conforms the description rules for this format. Once these lines have been put, it is mandatory to write a `<quipu>` XML tags. These tags must enclose all the information that describes a khipu.

This information is divided in four basic sections:

- **Catalog header.** This section contains tags related to the identification of the khipu described.
- **Media index.** This section contains indexed descriptions to features as color and materials used to build the cords of the khipu.
- **Metric Units.** This small section describes the units of measure used to describe lengths of the khipu.
- **Maincord Description.** This is the biggest section of a QDF file. Inside it is included the exact description of the khipu.
Each one of these sections are delimited by these tags:

- Catalog header: `<about> </about>`
- Media index: `<media_index> </media_index>`
- Metric Units: `<metric_unit/>`
- Maincord Description: `<maincord> </maincord>`

The occurrence of these sections must be in the order described.

3 Catalog Header

This section is enclosed by the `<about></about>` tags. Inside them it must be put new tags annotating its archeological source, dating, researcher code, and researcher (who encodes that khippu) data. Allowed tags are the following (in this order):

3.1 `<source> </source>`

(Required) Use this tag to record the archaeological place where the khippu comes from. Also it could contain the current location, as is a museum or a private collection.

3.2 `<dating> </dating>`

(Optional) This tag could contain the known dating of the khippu.

3.3 `<codename> </codename>`

(Required) There must be at least one pair of `<codename> </codename>` tags, containing the researcher code(s) used to identify the khippu. If the khippu has more than one codename, it can be put additional codename tags as necessary.

3.4 The `<author> </author>` subsection

(Optional) This subsection must be used to identify the data of the researcher who makes the transcription of the khippu to this QDF file. It must contain the following tags:

3.4.1 `<name> </name>`

(Required) The name of the researcher who generates the QDF file.

3.4.2 `<institution> </institution>`

(Optional) Institution where the researcher belongs.
3.4.3 <year> </year>
(Optional) Year of the generation of the qdf file.

3.4.4 <email> </email>
(Optional) Electronic mail of the reseracher.

3.4.5 <address> </address>
(Optional) Physical Address of the reseracher.

3.5 <comment> </comment>
(Optional) Use this tag to put any comment to the khippu, if necessary.

4 Media index

This section is enclosed by the <media_index> </media_index> tags. It contains a indexed list of features and characteristics of the materials used to build the khippu. These are encoded in one or several occurrences of the <material_item> </material_item> tags.

4.1 <material_item> </material_item>
(Required) These tags contain information required to describe both a minimal building material as a mixed material built from minimal ones already declared.

▷ Parameters:

• label: Brings a nickname or ID to refer that material subsequently in the file.

Inside these tags there must be the followings tags:

4.1.1 <description> </description>
(Required) This tag must describe the physical nature of the medium, typical values could be “wool” or “cotton” for this tag. In the case of a mixed material, it can hold the description of the mixing features.

4.1.2 <color_rgb/>
This empty tag must describe the color of the medium, expressed with a RGB hex value.
▷ Parameters:

• value: The RGB hexadecimal triplet value, in the format used as in HTML, #rrggbb.
4.1.3  `<color_icccnbs/>`

This tag must describe the color of the medium using a value in the ISCCNBS system.

▷ Parameters:
  - value: The ICCNBS value.

4.1.4  `<mix/>`

This tag is used to describe a material which is made from the mixture of more basic materials. It is typically used when describing cords built from smaller cords of different colors and/or materials.

▷ Parameters:
  - id: This refers to a material label previously declared in the media index section.

5  Metric units

This section is written using only one occurrence of the empty tag `<metric_unit/>`. With this small section it is specified the length units used in the description of the khipu.

▷ Parameters:
  - type: One value between "mm" for millimeters, "cm" for centimeters and "in" for inches.

6  Maincord description

This section is enclosed by the `<maincord> </maincord>` tags, and holds several entries of `<cord> </cord>` tags, each one of these describing both pendant, top and loop cords. There could be several occurrences of `<maincord> </maincord>` tags, when the described is a tied set of khipus. The maincord tags has also several parameters which describe the characteristics of the main cord of the khipu.

▷ Parameters:
  - dir: (Optional) Describes the construction torch direction of the cord. According Urton (2003), it could have the values "S" or "Z". If this option is not declared, a default value of "U" (unknown) is taken.
  - length: (Required) This option shows the length of the maincord, measured in the units chosen in the `<metric_unit/>` section.
  - width: (Optional) It describes the width of the maincord, measured in the units chosen in the `<metric_unit/>` section.
• **index**: (Optional) This option must be set only if the khippu described is a tied set of khippus, then each maincord tied gets a different index value.

• **material**: (Optional) This option refers to one material label indexed in the media index section. It describes the material of the maincord.

• **finish**: (Optional) Describes how is the finishing features of the maincord. Valid values are "knotted" if there is an ending knot, "broken" if it unfortunately is broken, and "none" if there is no ending knot.

6.1 Cords description.

The `<cord>` </cord> tags are the nucleus of the QDF system. There must be a `<cord>` </cord> tags for every pendant cord attached to the main cord. All the `<cord>` </cord> tags needed to describe a khipu must be inside a maincord tag. Any subsidiary cord is described as a `<cord>` </cord> tags nested inside a parent `<cord>` </cord> tags. This tag has the same options than the `<maincord>` </maincord> tags, plus some additional parameters:

> Parameters:

• **index**: (Required) This index could be given in a hierarchical form, related to the main cord or the pendant this cord belong (for subsidiaries). It is advisable, by example, to use a indexing system similar to the Ascher’s system (cita).

• **pos**: (Required) This option must indicate the position in the parent cord measured in the units chosen in the `<metric_unit/>` section, where the cord is attached.

• **attach**: (Optional) This option indicates the attaching way of the cord to its parent cord. According to Urton (2003), it must have one of these two values: "verso" or "recto". If this parameter is not given, a default value of "U" (unknown) is taken.

• **attach_through**: (Optional) This option must be set to "yes" if the given cord is a subsidiary that is attached through the parent cord. See the Ascher’s Quipu Databook (1978) for a complete explanation of this case. If not specified, a default value "no" is taken.

• **type**: (Required) This option indicates what kind of cord is it. Valid values are `pendant`, `top`, `subsidiary` and `loop`.

• **loop pos**: (Optional) This option is required if this is a loop cord. Its value must indicate the position where the cord is reattached to its parent cord, measured in the units chosen in the `<metric_unit/>` section.

A `<cord>` </cord> item can contain four sections: Attached pendants section, media section, knots section and transcription section.
6.1.1 Attached pendants section

This section is enclosed with the <attach_pendants> </attach_pendants> tags. This is used only in case of describing a top cord which is attached to the main-cord grouping a set of pendant cords (see Ascher,?). Inside this tag could be several occurrences of the tag <attaches/>, which possesses this parameter:

▷ Parameters:

- pendant: (Required) It refers to the label given for a previous cord described.

6.1.2 Media section

This section is enclosed by the <media> </media> tags. Inside, it contains a <material/> tag, which describes what material index composes the cord. When we found cords with segments made of different materials, we can put several occurrences of <material/>, according to the cord layout. The <material/> tag has the following parameters:

▷ Parameters:

- id: (Required) This option refers to one material label indexed in the media index section.
- pos: (Required) This is the position in the cord where that material finishes, measured in the units chosen in the <metric_unit/> section.

6.1.3 Knots section

This tags <knots> </knots> are used to describe the knotting on the cords. Each knot must be described by an occurrence of one of these tags: <single> </single>, <multiple> </multiple>, <eight> </eight>, which identifies the known knot types. The value it surrounds corresponds to the numerical value that it refers. These have the following parameters:

▷ Parameters:

- dir: (Optional) The direction of the knot. According Urton (2003), it can take one of these values "S" or "Z". If unspecified, a default value of "U" (unknown) if taken.
- pos: (Required) The position of the knot in the cord, measured in the units chosen in the <metric_unit/> section.

6.1.4 Transcription section

This optional section is enclosed by the <transcription> </transcription> tags, and holds a text which generally describes the numerical value that is stored in the cord.
7 QDF Example

<?xml version="1.0"?>
<!DOCTYPE quipu SYSTEM "qdf.dtd">
<quipu>
<!-- CATALOG HEADER -->
<about>
<source>Tocogua's Khipu</source>
<dating>1200AD</dating>
<codename>IZ001</codename>
<author>
<name>Manuel A. Izquierdo</name>
<institution>Observatorio Astronomico. UNAL</institution>
<year>2005</year>
<email>maizquierdop@unal.edu.co</email>
<address>Ciudad Universitaria, Bogota</address>
</author>
<comment>
A imaginary example khipu. Based on some contents on the Ascher's AS132 khipu.
</comment>
</about>

<!-- MEDIA INDEX -->
<media_index>
<material_item label="BS">
<description>Wool?</description>
<color_iccnbs value="BS"/>
</material_item>

<material_item label="LC">
<description>Cootom?</description>
<color_iccnbs value="LC"/>
</material_item>

<material_item label="YB:LC">
<description>Motted Wool?</description>
<mix id="BS"/>
<mix id="LC"/>
</material_item>
</media_index>

<!-- METRIC UNITS -->
<metric_unit type="mm"/>

<!-- MAINCORD DESCRIPTION -->
<maincord material="YB:LC" length="600" dir="Z">
<!-- First Cord -->
<cord index="X1" length="415">
<media>
<material id="LC" pos="20"/>
<material id="YB:LC" pos="415"/>
</media>
<knots>9


8 Quipu Description Format DTD.

<!--
Quipu Description Format DTD. Version 0.2
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<!ELEMENT quipu (about, media_index, metric_unit, maincord*)>
<!ELEMENT about (source,dating?,codename+,author?,comment?)>
  <!ELEMENT source (#PCDATA)>
  <!ELEMENT dating (#PCDATA)>
  <!ELEMENT codename (#PCDATA)>
  <!ELEMENT comment (#PCDATA)>
  <!ELEMENT author (name, institution?, year?, email?, address?)>
    <!ELEMENT name (#PCDATA)>
    <!ELEMENT institution (#PCDATA)>
    <!ELEMENT year (#PCDATA)>
    <!ELEMENT email (#PCDATA)>
    <!ELEMENT address (#PCDATA)>
<!ELEMENT media_index (material_item+)>
  <!ELEMENT material_item (description, color_rgb?, color_iccnbs?, mix*)>
    <!ATTLIST material_item label IDs #REQUIRED>
    <!ELEMENT description (#PCDATA)>
    <!ELEMENT color_rgb EMPTY>
      <!ATTLIST color_rgb value CDATA #REQUIRED>
    <!ELEMENT color_iccnbs EMPTY>
      <!ATTLIST color_iccnbs value CDATA #REQUIRED>
    <!ELEMENT mix EMPTY>
      <!ATTLIST mix id IDREF #REQUIRED>
<!ELEMENT metric_unit EMPTY>
  <!ATTLIST metric_unit type (mm|cm|in) #REQUIRED>
<!ELEMENT maincord (cord+)>
  <!ATTLIST maincord dir (S|Z|U) #IMPLIED>
  <!ATTLIST maincord length CDATA #REQUIRED>
  <!ATTLIST maincord index ID #IMPLIED>
  <!ATTLIST maincord material IDREF #IMPLIED>
  <!ATTLIST maincord finish (knotted|broken|none) #IMPLIED>
<!ELEMENT cord ( attach_pendants*, media, knots*, cord*,transcription?)>
  <!ATTLIST cord index ID #REQUIRED>
  <!ATTLIST cord length CDATA #REQUIRED>
  <!ATTLIST cord width CDATA #IMPLIED>
  <!ATTLIST cord pos CDATA #REQUIRED>
  <!ATTLIST cord dir (S|Z|U) #IMPLIED>
  <!ATTLIST cord attach (verso|recto|U) #IMPLIED>
9 References

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1978     Code of the Quipu: Databook. University of Michigan Press.

URTON, Gary .  
2003     Signs of the Inka Khipu: Binary Coding in the Andean Knotted-String Records. University of Texas Press.

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