An Ontology of Chinese Ceramic Vases

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USMB
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Chinese Ceramics
AGENDA

1. AIMS
2. DOMAIN
3. RELATED WORK
4. METHODOLOGY
5. DEVELOPMENT
6. EVALUATION
1. AIMS

**TAO CI aims to...**

01. Represent/model knowledge in the domain of Chinese ceramic pottery of the Ming and Qing dynasties in the form of an open ontology.

02. Provide a bilingual e-dictionary of ceramic pottery terms (English, Chinese).

03. Enrich existing methodologies for building domain ontologies.

04. Provide a reference for representing and linking objects from cultural heritage collections.
Between 1350 and 1750, Jingdézhèn 景德镇 was a major centre of production for nearly all of the world's porcelain. Ceramic vessels of Jingdézhèn imperial kiln sites represented the highest quality at the time.
2. DOMAIN

Criteria?

The objects selected:
- are as much different as possible from one another
- come from well-known collections of ceramic vessels in China
- the information on them is publicly available

Collections?

<table>
<thead>
<tr>
<th>Museum</th>
<th>Number of objects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palace Museum, Beijing</td>
<td>97</td>
</tr>
<tr>
<td>National Museum of China, Beijing</td>
<td>22</td>
</tr>
<tr>
<td>Guangdong Museum, Guangzhou</td>
<td>24</td>
</tr>
<tr>
<td>Shanghai Museum, Shanghai</td>
<td>4</td>
</tr>
<tr>
<td>Capital Museum, Beijing</td>
<td>2</td>
</tr>
</tbody>
</table>

Source for images: https://www.dpm.org.cn/collection/ceramic/227032.html
3. RELATED WORK

- CIDOC CRM - ICOM
- EDM - Europeana Data Model
- AAT - Art & Architecture Thesaurus
- ONTOCERAMIC Cantone et al., 2015
- O4DH Lekythos  [http://o4dh.com/lekythos](http://o4dh.com/lekythos)
4. METHODOLOGY

Principles

The following definitions come from ISO 1087-1, 2019:

Term → a term is a verbal designation of a concept
Concept → a concept is a unique combination of (essential) characteristics
Characteristic → abstraction of a property
Essential characteristic → a characteristic indispensable in order to understand the concept

The term-and-characteristics guided methodology is based on
ISO 1087 (Terminology work)
4. METHODOLOGY

**Workflow**

- **Step 1**: Scope and Objectives
- **Step 2**: Identify the essential characteristics
- **Step 3**: Differences between objects
- **Step 4**: Morphological analysis of Chinese terms
- **Step 5**: Building ontology by tools
- **Step 6**: Term-guided approach for defining concepts based on essential characteristics
- **Step 7**: Integration and Evaluation

**Resources**
- Books
- Database
- Internet
- Glossaries
- Dictionaries
- Lexicons
- Classification
- Schemes
- Taxonomies
- Thesauri

**Tools**
- RDF(S)
- Flogic
- OWL
Modeling with characteristics

**Essential characteristic**
- an *abstraction of a property of a concept* indispensable to understanding that concept (ISO 1087).
- defines the concept

**Descriptive characteristic**
- owns values which describe the *current state of an object*, e.g. weight, colour, etc.

**Essential characteristics** correspond to rigid predicates in DL (Guarino & Guizzardi, 2006) and to rigid properties in the OntoClean method (Guarino & Welty, 2004).

How to identify essential characteristics?
- Notice the differences between objects
- Analyze the morphology of Chinese terms

Morphology of vases

Vase parts are named after human bodies

Chinese vases

Greek vases
5. DEVELOPMENT

Please visit: http://www.dh.ketrc.com/dataset.html
5. DEVELOPMENT

- 165 classes
- 3124 axioms
- 11 object properties
- 8 data properties
- 132 individuals

Class | Properties | Individuals | Sparql | Visualization
## Ontology metrics

<table>
<thead>
<tr>
<th>Metrics</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axiom</td>
<td>3121</td>
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<tr>
<td>Logical axiom count</td>
<td>1492</td>
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<tr>
<td>Declaration axioms count</td>
<td>327</td>
</tr>
<tr>
<td>Class count</td>
<td>165</td>
</tr>
<tr>
<td>Object property count</td>
<td>11</td>
</tr>
<tr>
<td>Data property count</td>
<td>8</td>
</tr>
<tr>
<td>Individual count</td>
<td>132</td>
</tr>
<tr>
<td>Annotation Property count</td>
<td>15</td>
</tr>
</tbody>
</table>

### Class axioms

<table>
<thead>
<tr>
<th>Class axioms</th>
<th>Count</th>
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<tbody>
<tr>
<td>SubClassOf</td>
<td>469</td>
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<tr>
<td>EquivalentClasses</td>
<td>0</td>
</tr>
<tr>
<td>DisjointClasses</td>
<td>176</td>
</tr>
</tbody>
</table>
5. DEVELOPMENT

165 classes
9 top level classes

11 object properties

8 data properties

132 individuals
Domain & range

Emperor belongTo Dynasty
Domain & range

Vessel hasComponent Component
Main Classes

Annotations: Mouth

- **skos:prefLabel** [language: en] mouth
- **skos:prefLabel** [language: zh] 口
- **rdfs:comment** [language: en] It is used to indicate the vessel mouth that have different shapes.
- **rdfs:seeAlso**
  - [http://vocab.getty.edu/page/aat/300203331](http://vocab.getty.edu/page/aat/300203331)
Concept definition

<Arrow vase I>

Concept name

Terms

Definition

Formal Definition
## Ontology mapping

### Ontology prefixes:

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="http://www.dh.ketr.com/otcontainer/data/OTContainer.owl#">http://www.dh.ketr.com/otcontainer/data/OTContainer.owl#</a></td>
<td>OTContainer</td>
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<td>CRM</td>
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<td>FOAF</td>
</tr>
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<td>OWL</td>
</tr>
<tr>
<td><a href="http://www.w3.org/2002/07/owl#">http://www.w3.org/2002/07/owl#</a></td>
<td>RDF</td>
</tr>
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<td><a href="http://www.w3.org/1999/02/22-rdf-syntax-ns#">http://www.w3.org/1999/02/22-rdf-syntax-ns#</a></td>
<td>RDFS</td>
</tr>
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<td><a href="http://www.w3.org/2000/01/rdf-schema#">http://www.w3.org/2000/01/rdf-schema#</a></td>
<td>SCHEMA</td>
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<td><a href="http://www.w3.org/2004/02/skos/core#">http://www.w3.org/2004/02/skos/core#</a></td>
<td>SKOS</td>
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<td><a href="http://www.w3.org/2001/XMLSchema#">http://www.w3.org/2001/XMLSchema#</a></td>
<td>XSD</td>
</tr>
</tbody>
</table>

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**Art & Architecture Thesaurus**
Arrow Vase I

Terms (prefLabel):
arrow vase I [EN]
贯耳瓶 I [ZH]

Concept Name:
<ArrowVase square mouth slanting shoulder bulge belly square foot>

Definition:
Arrow vase with a square mouth, slanting shoulder, bulge belly, and square foot [EN]
贯耳瓶有一个方形口，斜肩，垂腹和方足。[ZH]

Comment:
The "arrow vase I" is a new term (neoterm) introduced to distinguish the different types of arrow vases.

Essential Characteristic
- has component: /Slanting Shoulder/
- has component: /Square Foot/
- has component: /Square Mouth/
- has component: /Bulge Belly/
- has function: /Function For Decoration/
- is fired at: /High Temperature/
- is made of: /Clay/

See also
https://www.dom.org.cn/collection/ceramic/227009.html
TAO CI ontology has been submitted to

OOPS!

OntoMetrics

http://oops.linkeddata.es/

https://ontometrics.informatik.uni-rostock.de/ontologymetrics/
## OntoMetrics scores

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attribute richness</td>
<td>0.048485</td>
</tr>
<tr>
<td>Inheritance richness</td>
<td>2.715152</td>
</tr>
<tr>
<td>Relationship richness</td>
<td>0.334324</td>
</tr>
<tr>
<td>Class/Relation ratio</td>
<td>0.245171</td>
</tr>
<tr>
<td>Average population</td>
<td>0.8</td>
</tr>
<tr>
<td>Class richness</td>
<td>0.321212</td>
</tr>
</tbody>
</table>

https://ontometrics.informatik.uni-rostock.de/ontologymetrics/
OntoMetrics scores: discussion

The main goal of TAO CI is to classify vases
- not represent relationships
- not populate

Why are Tao Ci OntoMetrics scores low in terms...
...of Class & Attribute richness?
because essential characteristics are translated as classes without any attributes in DL

...of Class/Relation ratio & Relationship richness?
because the aim of the ontology is not to relate with other objects

...in terms of Average population?
because the aim is not to populate
Validation using Competency Questions

Ontology Design Best Practices

- rewrite competency questions into a query language (SPARQL)
- test that each question can be answered correctly using the classes, properties and instances defined earlier
## Competency Questions

<table>
<thead>
<tr>
<th>CQ</th>
<th>Competency Question</th>
<th>Class</th>
<th>Relation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>What are the different types of vase?</td>
<td>Vase</td>
<td>vase-type is-a Vase</td>
</tr>
<tr>
<td>2</td>
<td>What material is vase the made of?</td>
<td>Vase, material</td>
<td>Vase is made of Material</td>
</tr>
<tr>
<td>3</td>
<td>What is the color and glaze of the vase?</td>
<td>Vase, Glaze-color,</td>
<td>Vase glaze-color is</td>
</tr>
<tr>
<td>4</td>
<td>Which dynasty is the vase?</td>
<td>Vase, Dynasty</td>
<td>Vase hasDynasty Dynasty</td>
</tr>
<tr>
<td>5</td>
<td>Which emperor is the vase?</td>
<td>Vase, Emperor</td>
<td>Vase hasEmperor Emperor</td>
</tr>
<tr>
<td>6</td>
<td>What are the Chinese and English terms of the vases</td>
<td>Vase</td>
<td>Vase label string</td>
</tr>
<tr>
<td>7</td>
<td>What are the components of the vase?</td>
<td>Vase, Component</td>
<td>Vase hasComponent</td>
</tr>
<tr>
<td>8</td>
<td>What is the function of the vase?</td>
<td>Vessel, Function</td>
<td>Vessel hasFunction Function</td>
</tr>
<tr>
<td>9</td>
<td>Which dynasty does the emperor belong to?</td>
<td>Emperor, Dynasty</td>
<td>Emperor belongTo dynasty</td>
</tr>
<tr>
<td>10</td>
<td>Where is the vase x collected in?</td>
<td>Vase x</td>
<td>Vase x is Collected In string</td>
</tr>
<tr>
<td>11</td>
<td>Which kiln is the vase x produced?</td>
<td>Vase x</td>
<td>Vase x is produced in string</td>
</tr>
<tr>
<td>12</td>
<td>What is vase x decorated with?</td>
<td>Vase x</td>
<td>Vase x is decorated by string</td>
</tr>
<tr>
<td>13</td>
<td>What is the image of vase x?</td>
<td>Vase x</td>
<td>Vase x image string</td>
</tr>
</tbody>
</table>
Competency Question 6

Q6

PREFIX skos: <http://www.w3.org/2004/02/skos/core#>
PREFIX otc: <http://www.dh.ketr.c.com/otcontainer/data/OTContainer.owl#>
SELECT ?english_name ?chinese_name
WHERE {
  ?vase rdfs:subClassOf* otc:Vase.
  FILTER (lang (?english_name)="en")
  FILTER (lang (?chinese_name)="zh")
}
ORDER BY ?english_name

Image source: https://www.dpm.org.cn/collection/ceramic/227893.html?hl=%E8%B4%AF%E8%80%B3%E7%93%B6
Tao Ci Objectives have been successfully met:

Tao Ci provides:

- a knowledge representation of Chinese ceramic of the Ming and Qing dynasties in the form of a domain ontology to be published in the LOD
- a bilingual (Chinese-English) e-dictionary of vases based on the domain ontology were met
- a term-and-characteristic guided methodology derived from taking into account the ISO principles on Terminology
Summing it all up ...

Solved! The problem of expressing essential characteristics modelled in Protégé:

- Essential characteristics cannot be directly expressed in Description Logics.
- We proposed to represent them as classes.
- Owning an essential characteristic for a concept (class) is then represented as a restriction of an object property whose range is the class associated to the essential characteristic. This means that the concept (class) is a subclass of the anonymous class defined by the restriction.

Modeling using essential characteristics is expert friendly because...

- It is object-oriented: experts work with differences -structural or functional- between objects.
- It is term-guided: experts work with terms - Chinese characters convey a lot of useful semantic information about vases.
Thank you!

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Contact: Tong, Wei 位 tong.wei@univ-smb.fr or weitong315@163.com
http://www.dh.ketrc.com/contact.html
Modeling with essential characteristics

/mouth/

It is used to describe the vessel mouth shape that looks like a garlic bulb.
Modeling the characteristic /mouth/
Annotions: FlowerShapedMouth

Annotations: FlowerShapedMouth

Annotations

skos:prefLabel [language:en]
flower shaped mouth

skos:prefLabel [language:zh]
花形口

rdfs:comment [language:en]
It is used to describe the shape of the vessel mouth that looks like a flower.

Description: FlowerShapedMouth

Equivalent To

SubClass Of
- Mouth

General class axioms

SubClass Of (Anonymous Ancestor)

Instances

Target for key

Disjoint With
- Garlic ShapedMouth
- BrushWasher ShapedMouth
- Plate ShapedMouth
- Trumpet ShapedMouth