Design of Museum Guide Mobile Application to Recommend Abstract Art

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Abstract. We propose an ontology based expert system to help people or machine appreciate abstract art. As basic research, we build linguistic variables and rules to formulize the ambiguity of composition elements in Mondrian's art based on the rules of experts. The prototype of expert system for Mondrian's art is implemented using Apache Jena framework. The rules to understand implicit meaning of composition elements in Mondrian's art constitute the knowledge base implemented by Jena framework. The performance of the prototype is verified by experiment with people who have different levels of knowledge that the proposed system works efficiently to analyze the ambiguity of composition elements in abstract art. The proposed system can be used to develop PC, web or mobile applications to help normal people to understand difficult abstract art.

Keywords: Abstract art; Mondrian; Expert system; Jena framework.

1   Introduction

In general, ordinary people who do not have the expertise about art are difficult to appreciate abstract art. A study using fMRI scans shows that representational paintings are preferred over abstract paintings by ordinary people [1]. However, another study shows that experts have greater flexibility and differentiation in art appreciation against non-experts, irrespective of the genre [2]. In other words, some modern arts such as abstract art are not enjoyed not because of lack of artistic value but lack of knowledgeable accessibility. As a result, if people learn the expertise about abstract art and understand how to appreciate it, they can expand the aesthetic experience. Similarly, most abstract visual media is not popular to ordinary people because they are difficult to be understood without artistic expertise.

Modern artists have tried to help people understand complicated and metaphysical modern arts. For example, art docents voluntarily serve to help spectators in a gallery or a museum. Due to the limitation of volunteers, artificial docents based on the

computer systems have been developed and deployed [3]. In addition, recently museums have replaced traditional handhelds to provide audio guidance with mobile guide application for low cost and user convenience. Some human docent, mobile guide application and most legacy artificial docents deliver directly the information and the interpretation of artworks, but they do not explain the way to appreciate artworks. Therefore, spectators can temporarily understand the artwork, but cannot learn and develop expertise to appreciate convoluted modern art such as abstract art. In this work, we propose an expert system that analyzes the ambiguity of composition elements in abstract art to help ordinary people learn how to understand abstract art by exploiting the knowledge and rules of experts.

In artificial intelligence, an expert system is a computer system that emulates the decision-making ability of a human expert [4]. Expert systems are designed to solve complicated problems by reasoning about knowledge of experts, represented as if–then rules. User input facts to evaluate through user interface. Knowledge base has facts about the problem and if–then rules, and inference engine evaluates the input, applies relevant rules and draws a conclusion. For example, a user can input the answers to the questionnaire, then the expert system can recommend specific Mondrian's art which is most appropriate to the answers by the knowledge base and the inference engine.

In this paper, we represent and implements an ontology based expert system using Jena framework to appreciate abstract art. Mondrian's abstract is selected as examples, because he is one of the most important pioneers in abstract art as well as most of his works are composed of simple lines and specific colors those are easy to be formulized by compute language. The proposed system can be applied to mobile museum guide application or artificial docent system.

2   Design of Expert system

2.1   Conceptualization and Formalization

Table 1. Formalization

Concept	Relation
Attitude	The attitude that the work take is closely related to the form of the canvas.
Characteristics	The characteristics that the work have is closely related to the ratio of horizontal lines and vertical lines in the work.
Ideology	The ideology that the work reflects is closely related to the intersections of horizontal lines and vertical lines in the work.
Will	The will that the work represents is closely related to use of achromatic colors in the work.

Emotion and Reason	The Emotion and Reason that the work represents is closely related to use of chromatic color colors in the work

2.2   Design of Knowledge Base and Inference Engine

The composition elements including the form of canvas, horizontal and vertical lines, and colors are related to the key concepts of the work. Base on the formalization, we derive the rules for the inference engine. Based on literature analysis of criticism and of Mondrian's abstract art, we classify composition elements into 5 groups and define 19 rules to build the knowledge base and inference engine of the expert system as shown in Table 2. Due to limitation of space, one representative rule of each category is presented in Table 2. The rules in Attitude are related to the form of canvas. The rules in Characteristics are related to the ratio of vertical lines and horizontal lines used in the work. The rules in Ideology are related to the ratio of intersections between vertical lines and horizontal lines. The rules in Emotion and Reason are related to the ratio of chromatic colors used in the work. The rules in Will are related to the ratio of achromatic colors used in the work, especially for boundary lines.

Table 2. Knowledge Base for Mondrian's works

No.		Condition	Conclusion
Attitude	Rule 1	IF attitude is balance or attitude is neutral or attitude is completeness.	THEN canvas is a form of square.
Characteristics	Rule 5	IF Character is enterprising or Character is outgoing or Character is active.	THEN vertical lines are dominant. (>60%)
Ideology	Rule 8	IF tendency is progressive or tendency is distribution or tendency is revolution.	THEN most vertical and horizontal lines are intersected. (>80%)
Emotion and Reason	Rule 11	IF Emotional and rational is emotional or Emotional and rational passionate.	THEN red is dominant between red and blue.
Will	Rule 16	IF intention is firm or intention is decision.	THEN black lines are dominant between black and grey.

3   Implementation

Jena supports the abstract process of deriving additional information and the term reasoner to refer to a specific code object that performs this task. 3.1 shows the part of RDF implementation by Jena for the prototype of the proposed expert system [5]. We implemented the whole knowledge base and inference engine by Jena platform.

3.1 Program Code

Example of a RDF Implementation by Jena

```
@prefix ex: http://example.com/culturalassetManagement#
 [FinalRule_4: (?s rdf:type
          ex:LozengeCompositionwithRedGrayBlueYellowandBlack   <-
          (?s ex:recommandation 'ok' ^^xsd:string)
              (?s ex:canvas 'canvasisaformofdiamond' ^^xsd:string)
          (?s ex:horizontalandverticallinesare 'horizontalandverticallinesarebalanced'
^^xsd:string)
            (?s ex:verticalandhorizontallines
            'mostverticalandhorizontallinesareintersected' ^^xsd:string)
             (?s ex:color 'redandbluearebalanced' ^^xsd:string)
             (?s ex:grey 'blacklinesisdominantbetweenblackandgrey' ^^xsd:string)
  ]
```

4   Conclusion

The proposed system is a prototype of expert system to appreciate abstract art. In this work, we classify composition elements of Mondrian's works into just 5 groups. To appreciate any abstract art, we generalize the classification of composition elements and design a general framework of rule-based expert system. The prototype is implemented based on Jena framework and verified the facts and rules in the expert system. As expert systems have developed and applied to support users and experts in various areas, we expect that the artificial docent system based on expert system can contribute to narrow the gap between ordinary people and contemporary artist.

References

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