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Pattern Extraction from Human Preference Reasoning Using Conditional Probability Co-occurrences Matrix of Texture Analysis*

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Abstract

A new approach is proposed for extraction of features from human preferences reasoning. Conditional Probability Table (CPT) is a mentality representation to control the reasoning in Bayesian Belief Network (BBN). A software tool was developed using texture analysis with a co-occurrences matrix algorithm. As a case study, it was tested on BBN of moss (*Rhacomitrium canescens*) produce preferences. The result successfully represented features extracted as specific patterns. It is applicable as a new computational method for reducing many concrete parameters (Dimensionality) and extracting the information from CPT in five textural features. These features are essential as abstractive parameters for designing customized agro-industrial production to provide every consumer with a produce that matches his or her unique preferences.

[Keywords] Bayesian belief network, conditional probability, knowledge, moss greening produce, preference, texture analysis

I Introduction

A significant success for introducing new customized agro-industrial produce depends on incorporating the desired consumer preferences in the production control system. The reasoning available on this is very limited. The reasoning can be represented using different kinds of models: rule-based models for human expertise, statistical models for data, or physical models. Bayesian belief network (BBN) has gained a reputation for modelling complex reasoning problems involving human knowledge and uncertain impact of causes to predict their decision (Henriksen *et al.*, 2007).

The structure of BBN consists of parent (*A* and *B*) and child nodes (*C*) as shown in Fig. 1. A child node has an underlying Conditional Probability Table (CPT) that describes the probability distribution across the states of that specific node for each possible combination of (*n*) states of the parent nodes. CPT is a human mental representation to control the reasoning in BBN. In cognitive psychology, conditional probability is central to reasoning and decision making (Over *et al.*, 2006). Besnard *et al.* (2004) has highlighted the relationships among knowledge, mental model and co-occurrences. In this research hypothesis, CPT is assumed to be a mental model consisting of conditional probability co-occurrences.

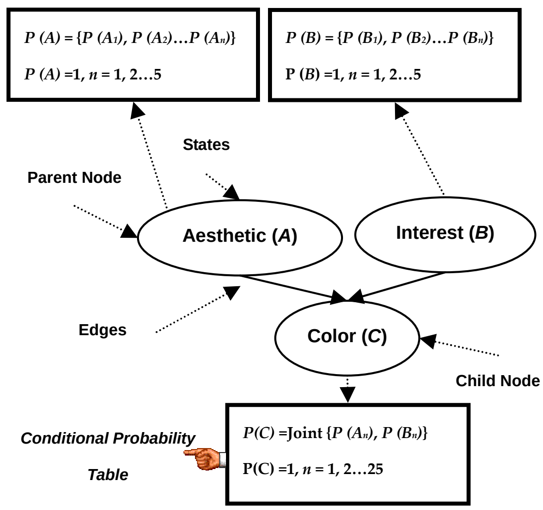

Fig. 1 An example of BBN structure on moss preferences

This research addresses a requirement for pattern extraction to solve two problems in production systems related to CPT. Firstly, BBN boasts of many concrete parameters due to parent-child dependencies. It contains large and complex dimensions of CPT in the reasoning data base. Pattern

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extraction is necessary to reduce the dimensionality of CPTs into specific features (Ushada and Murase, 2007). Secondly, the features are essential as abstractive parameters for control and system identification in a customized agro-industrial production incorporating the result in Ushada *et al.* (2007). The expected outcome is to provide every consumer with a produce that matches his or her unique preferences (Fig. 2).

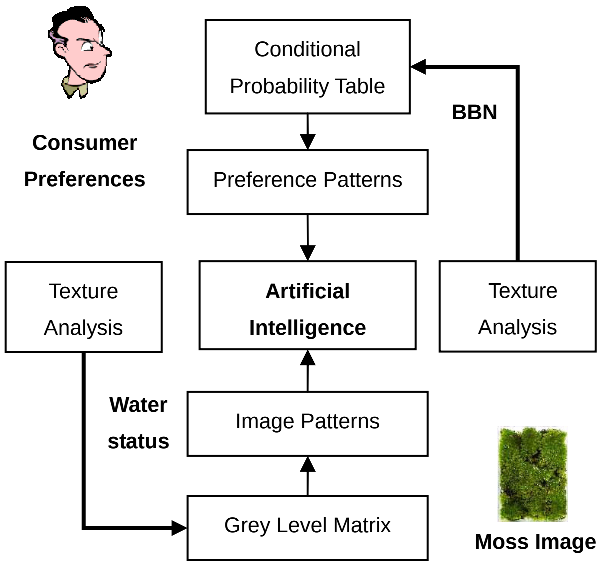

Fig. 2 Impact of the research connecting with previous work (Ushada *et al*., 2007) for customized produce

To solve the problems, a software tool was developed using texture analysis with a co-occurrences matrix algorithm. The objectives were: 1) to extract patterns from human preferences as specific features; 2) to find a new approach for computational method to reduce the dimensionality of CPT in human preferences reasoning data bases. The expected outcomes are: 1) As a new method to generate the abstractive parameters of preferences for designing customized agro-industrial production; 2) As a new method for extracting information from preference reasoning. The implementation of algorithm is demonstrated in detail via a case study on BBN of moss (*Rhacomitrium canescens*) produce preferences. The produce has been used as greening technology to ease the urban heat island effect (Ushada and Murase, 2006).

II Materials and Methods

1. Materials

A total of 98 prospective consumer candidates from Japanese, Indonesian and Foreigners were selected as respondents in a preference based-questionnaire. The questionnaire provides the produce image visualization in the form of 3 products of greening technology (Figs. 3a, 3b and 3c) and four proposed modules of customized produce related to water status (Ushada *et al.*, 2007). These images solicit the visual imagery for respondents to express their preferences.

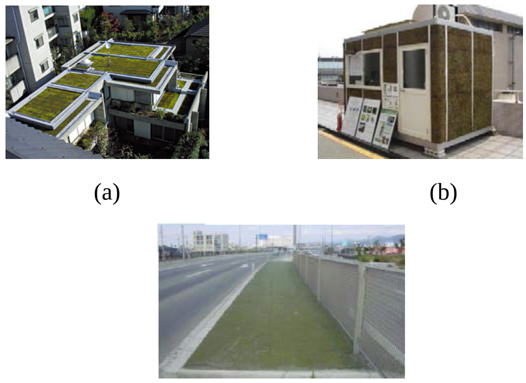

Fig. 3 Visual imagery of greening technology; (a) Rooftop; (b) Wall; (c) Ground greening.

2. Conditional probability table

Grey Level Co-occurrences Matrix (GLCM) can provide pattern extraction for a number of textural features (Haralick *et al.*, 1973). Murase and Fukui (2004) have utilized texture analysis to extract the pattern from a transcriptional site.

In this research, Conditional Probability Co-occurrences Matrix (CPCM) algorithm is highlighted. The object is a CPT as an analogue to a grey level matrix in GLCM. Each of CPT has rows and columns (Table 1). 25 rows refer to conditional probability and 5 columns refer to attributes scale. CPT size can be defined as 25×5 for colour preference. 31 CPT were generated by raw data and weighted random from questionnaire (Table 2). The last method is inspired from Das (2004) to test the algorithm by noisy effect of random number. A noisy CPT is assumed as a human mental representation which is influenced by many noisy social factors. Attribute responses were mainly obtained through Likert scale by open and closed questions. The reasoning was built deterministically from questionnaire. The other attributes have no reasoning due to the assumption of independency.

Table 1 CPT dimension of colour preference (25×5)

				Attributes scale				
	No	Aesthetic	Interest	1	2	3	4	5
Conditional probability	1	Strongly Disagree	Strongly Dislike	0	0.013	0.399	0.335	0.253
	…	…	…	…	…	…	…	…
	24	Strongly Agree	Like	0	0.076	0.177	0.496	0.251
	25	Strongly Agree	Strongly Like	0	0.136	0.299	0.438	0.127