



Multiple views system to support awareness for cooperative design



Changyu Chen, Gang Zhao, Yong Yu*, Haiyan Deng

School of Mechanical Engineering and Automation, Beihang University, Beijing, China

HIGHLIGHTS

- We devise a cooperative awareness model to describe cooperative awareness information in product design.
- We propose concept of awareness intensity and an object-oriented method to identify and filter overloaded cooperative awareness model.
- A mechanism which responds to changes of lean cooperative awareness information is proposed to plan and execute task in product design.
- A navigation net managed by a multiple views system is proposed to browser lean cooperative awareness information set.

ARTICLE INFO

Article history:

Received 15 December 2013

Accepted 9 January 2015

Keywords:

Multiple view

Cooperation awareness

Cooperative design

Information overload

ABSTRACT

It is acknowledged that multiple views technology improves designer's work efficiency by filtering redundant information. However, the increased need of cooperative activities in product design process requires views incorporating Cooperative awareness information (CAI), content of which should be lean for understanding and sortable according to importance. To achieve this target, this paper proposes an Object-based cooperative awareness model (OBCWM) and corresponding multiple views system. Requirements of CAI in product design are firstly analyzed. Then OBCWM is proposed, which consists of a CPM (Core product model) based concept framework. By use of CPM, an algorithm to calculate awareness intensity is developed based on object-oriented method. To support the mechanism of OBCWM, a multiple views system is then designed with "flexible view", content of which is adjustable according to awareness intensity between CAI objects. After introduction to the system, application on a case is presented, followed by the evaluation of this system.

© 2015 Elsevier Ltd. All rights reserved.

1. Introduction

To perform a cooperative design task, designers need to know situation information of cooperative environment and other designers involved as basis of decision making [1]. In the domain of Computer Supported Cooperative Work (CSCW), the situation information is called Cooperative awareness information (CAI). CAI plays a significant role in concurrent engineering [2,3] and favors efficient cooperation of professionals from different disciplines. An efficient cooperative design system has two basic requirements:

(1) Define CAI. Namely, the system shall first define CAI according to designers' requirements.

(2) Filter overloaded CAI. It shall provide accurate CAI to designers by filtering overload CAI. With sharp increase of product complexity, designers need to interact with lots of CAI sourced from mass cooperative activities in the same cooperative environment.

This explains the generation of information overload. Information overload makes it hard to provide accurate information for designers and their attention will be badly distracted. To avoid negative influence of CAI overload, an improved CAI support system is needed to provide designers with a lean CAI set.

To meet the two requirements of cooperative design system, this paper propose an object-oriented Cooperative awareness Model and a multiple views system based on this model.

Innovations of this paper are as follows:

(1) This paper proposes an object-oriented Cooperative awareness model (CWM) and algorithms to describe design task and awareness information, and hereby calculate the lean CAI set for a specific task.

(2) This paper proposes a concept of "flexible view" to acquire CAI according to awareness intensity between the CAI and design task.

This paper is organized as follows: Some related works with regard to overload CAI filtering and CAI definition are briefly introduced in Section 2. In Section 3, we address detail information of Object-based CWM (OBCWM), include awareness requirements of CWM, foundation, framework and mechanism of OBCWM.

* Corresponding author.

E-mail address: yuyong@buaa.edu.cn (Y. Yu).

Section 4 introduces multiple views system based on OBCWM, followed by a case study in Section 5 to exemplify the application of this model and system. Evaluation of the system is presented in Section 6 before we reach the final conclusion.

2. Related works

2.1. Information overload filtering

Generally, there are three resolutions to filter overload information [4]:

(1) Improving designer's information-processing skills by training;

(2) Assure high quality of CAI by visualization, compressed and aggregated method, such as Information Architecture [5,6];

(3) Pre-processing and filtering CAI through information tools.

Since this paper focuses on developing an information system, which should be classified into the third resolution, we will only introduce related works of information tools which include Information Recommender System, Information Logistics System and Multiple Views System.

Information Recommender (IR) System. This system defines relationship between information and user by data analysis method. It uses information clustering (clustering analysis) method to quantify relationship between target data. It infers information demands of users by analyzing the user's profiles and history information interactions. Then the system matches user's information needs with information topics to help user acquire the lean CAI set [7,8].

In cooperative design environments, designer's information demands will be affected by his/her role and task attributes. Thus Zhen et al. [9,10] proposed an information recommender system based on workflow which introduced factor of task relationships derived from workflow into its algorithm. Referral information is changed according to busy degree of designer. Kim and Lee [11] proposed a method analyzing user profile in workflow and information flow of cooperative work to provide more accurate CAI. In addition, context information is analyzed to improve accuracy of referral CAI.

Information Logistics (IL) System. The goal of information logistics is to enable the effective and efficient delivery of needed information in the right format, granularity and quality, at the right place, at the right point in time to the right actors [12]. This system uses method of "user-demand Information-supply" [13] and Semantic technology to map information to information demands. Michelberger proposed Process-Oriented Information Logistic (POIL) and an information push system which combines information-, context-, and process-awareness. With this system, process participants do not have to actively search for relevant process information anymore, but are automatically supplied with needed process information—even if their work context is dynamically changing [14].

Multiple Views (MV) System. This system uses two or more distinct views to support the investigation of a single object from different perspectives or levels of detail [15]. In information system of manufacturing enterprises, multiple views system creates mapping relationship between user's information needs and permission [16–19] according to a specific access control model, and hereby determines contents of views for different users. This system not only satisfies information safety [20] and sharing needs of enterprises, but also plays a significant role in human recognition. It relieves distraction [17] and information anxiety [21] caused by overload CAI and provides design workspaces for digital product designers.

Two types of solution taken by above studies can be concluded: In IL and MV, main idea is to make accurate definition of relationships between target information and users. In IR, main idea is to calculate relevance of information set in specific dimension, which is approximate to user's requirements.

Table 1
Awareness list [28].

Awareness	Question
Social awareness	<ul style="list-style-type: none"> ● What should I expect from other members of this group? ● How will I interact with this group? ● What role will I take in this group? ● What roles will the other members of the group assume?
Task awareness	<ul style="list-style-type: none"> ● What do I know about this topic and the structure of the task? ● What do others know about this topic and task? ● What steps must we take to complete the task? ● How will the outcome be evaluated? ● What tools/materials are needed to complete the task? ● How much time is required? How much time is available?
Workspace awareness	<ul style="list-style-type: none"> ● What are the other members of the group doing to complete the task? ● Where are they? Are they active in the workspace? ● What are they going to do? ● What are they doing? What are their current activities and tasks? ● What have they already done? ● What will they do next? What do they need me to do next? ● How can I help other participants to complete the project? ● Where can they have effects? What changes are they making?

2.2. CAI definition

CWM provides efficient mechanism to collect, describe, publish and display CAI [22]. As the core of CSCW [23], CWM determines the content and supportive method of awareness.

Typical existing CWMs include spatial model [24], workspace awareness model [25] and role-based model [26]. The spatial awareness model proposed by Benford abstracts relationships between objects, and defines awareness as interaction of objects through specific media. Workspace awareness model proposed by Gutwin combs the awareness needs of users during the process of cooperative design. Role-based awareness model [26] defines task, role, object and their relationship, and then defines awareness intensity between the roles. Actually, as application of ubiquitous devices gradually matures, more awareness model theories have emerged [27].

The spatial model [24] is proposed for virtual environment. It depicts awareness between different "objects" in a common spatial environment. But the range of "object" is too large to apply to detailed product information.

Based on workspace model, Gutwin proposed his groupware [25]. It is more suitable for communication and execution than co-operation planning.

The space model and workspace model mainly focus on human's activities perceived by collaborators.

The role-based model [26] consists of relationship between task, role, object, activity and the user, and explains cooperation design from the view of organization. It is suitable to depict the assignment in cooperative design. However, the concept of "object" is still too simple to explain complex information corresponding to product information model.

To catch CAI in collaborative design, Farouk et al. [28] proposed a situation model, which covered CAI of technical and organizational activities at three organizational levels. As shown in Table 1, Farouk synthesized three types of awareness requirements in

Download English Version:

<https://daneshyari.com/en/article/440039>

Download Persian Version:

<https://daneshyari.com/article/440039>

[Daneshyari.com](https://daneshyari.com)