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An Approach of Information Processing for CBR in Emergency Management Engineering

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Abstract

Emergency management engineering provides the logical and systematic process for reacting to the incidents and determining the treatment opinions. Presently many researches dedicated to the application of case based reasoning (CBR) in emergency engineering. However, usually the ideal cases in emergency domain are not available and hard to obtain. The distance between raw information and cases lies in the middle of information processing and CBR application, making it difficult to design practical CBR systems. Alternatively, this paper proposed an approach of generating imperfect cases from raw information with information evaluation and ranking. First, the derivation of information was assessed. Moreover, to implement that strategy, the technique of natural language process is employed. The gathered information was labeled with keywords, and the keywords gained the weight according to the word frequency and the ontology. Finally, the case was represented by a set keywords with their weights. For many emergency domains, this strategy partly solved the above problem of insufficient cases, and supported the decision making to some extent.

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1. Background

Recently with the increasing occurrence of disasters or instances, emergency management engineering, which provides the logical and systematic process for reacting to the incidents and determining the treatment opinions, becomes necessary and high on the research agendas. Unlike the management engineering in other domain, the emergency management engineering is under the circumstances of inadequate information, changing conditions and high urgency, thus the methodology of models or rules cannot satisfy the requirement of emergency management.

CBR is a methodology to solve new problems with previous experience. It contains four phases, or four "res", as known as to retrieve the most similar cases, to reuse them, to revise the proposed solution, and to retain the current cases. Since CBR was put out by Schank in 1977, it has achieved great success in amount of fields, such as medical science, information science, industrial context, etc. The heterogeneity of the application domains demonstrates the flexibility and capability of CBR to handle issues which would be too difficult to manage with rules or models [1]. Consequently, a lot of efforts have been devoted to apply CBR (Case-based Reasoning) in emergency engineering. However, this time CBR does not achieve the expected performance.

The main difficult of CBR in emergency engineering is the organization of disaster or incident cases, which is an essential element in applications of CBR. Usually the design of CBR system assumes that the cases are already available, and the all of the involved fields are where experiential cases can be easily obtained and collected. Nevertheless, the domain of emergency engineering is not equivalent in that it concerns amounts of information,

such as the description of incident, the involved agencies, the emergency response, the results and evaluation. The information cannot compose a ‘case’ only when they were engineered to be ordered.

This paper focuses on the initial step of CBR, which means the “C”, in other words, the cases. In that the distance of raw information to the cases is still a vacancy of applying CBR in emergency engineering. The organization of the paper is as follows. In section 2 we review the current work related with application of CBR and information processing in emergency engineering. In section 3 we discuss the difficulty of obtaining disaster cases. In section 4 we describe an architecture for information processing to transform information into cases, and demonstrate the feasibility of the approach with some examples. In section 5 we briefly outline the potential function of the engineered information. And in section 6 we summarize the ideas discussed throughout the paper.

2. Related works

2.1. Application of CBR

Currently there are already many researches dedicated to the application of CBR in emergency engineering, which involve the representation of disaster cases, the framework of CBR in emergency engineering, and the design of CBR system in special disaster domain, etc.

Substantial researches employed the ontology theory to represent the emergency cases. Malizia A. designed an ontology model for emergency notification systems accessibility [2]. Sotoodeh M. built an ontology model to describe the interoperability of disasters, the communal facilities, the local conditions and the emergency staffs [3]. Josefa Z. pointed out that the ontology should contain at least three parts of the events, the development, and the response actions [4].

Besides the representation, some researchers put their efforts to design the framework of CBR in emergency engineering, and some CBR systems have been accomplished. B. Chakraborty built a fire emergency handling system based on a java platform that uses CBR to assist decision making in solving a fire problem case[5]. The system receives a current fire emergency condition as a query with several attributes, like fire location, area under fire, and wind velocity, etc. With this attributes the system configures the similarity to retrieve the cases most similar to the given query. After adaptation depending upon domain knowledge, it figure out a solution containing type of extinguisher, number of fire engines, the remedial actions taken, and otherwise. It also has the revising and retaining steps [5].

2.2. The information processing

A lot of works are dedicated to establish the information standard concerning emergency engineering. OASIS proposed common alerting protocol in 2005 to describe alerting information and emergency data exchange language in 2008 for emergency resources and process [6]. Sun S. designed cyclone warning markup language based on Hurricane Katrina [7].

On the other hand, some researches try to design information systems to engineer emergency information. Marcos R. S. Borges proposed a scheme based on linked open data (LOD) for collecting and integrating available data from government agencies [8]. And Chen-Huei Chou developed a structure of identifying useful elements on web sites [9].

The current works implicate that the CBR could not be applied only after an in-depth analysis with domain knowledge, moreover, the cases must be structured or half-structured. Meanwhile, amounts of concerned information is text-based, which undermines the application of CBR in emergency engineering. At the same time, the technologies of emergency information processing have not been employed to transform information to available cases, thereby to support application of CBR yet.

3. The disaster cases

Typically, the case should at least contain detailed information with the situation description, the emergency subjects, the emergency objects, the developmental process and the evaluated results, etc. however, as there are

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