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Multilingual Knowledge Management for Crisis

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Abstract

In a crisis all rescue forces, government agencies, volunteers, and business sectors work together to supply immediate relief efforts. The problem of the lack of a shared platform or similar communication methods among the collaborators usually arises within a few hours. The paper presents an outline of an ontology model for the construction of a common platform for sharing different concepts in different languages and coordinating rescue forces. Motivation is supplied by the Boxing Day Tsunami crisis.

Keywords: Crisis, multilingual knowledge, ontology

1. Ontologies and Multilinguality

Ontologies are currently considered the de-facto standard for representing semantic information. Their design, however, is a difficult task, requiring the collaboration of ontology engineers and organization experts. Therefore, ontologies are manually crafted and tuned, which results in a static domain model, infrequently modified. Nevertheless, once designed their universal nature makes them an excellent mechanism for application interoperability.

A common definition of an ontology considers it to be “a specification of a conceptualization” (Gruber, 1993), where conceptualization is an abstract view of the world represented as a set of objects. The term has been used in different research areas, including philosophy (where it was coined), artificial intelligence, information sciences, knowledge representation, object modeling, and most recently, eCommerce applications. For our purposes, an ontology $O \equiv (V, E)$ is a directed graph, with nodes representing concepts (vocabulary or things (Bunge, 1977), (Bunge, 1979)) associated with certain semantics and relationships (Russell and Norving, 2003). For example, a crisis concept can be *Supply Chain* which will be associated with both the concept of *Management* and the concept of *Food Aid*, as displayed in Figure 1.

The static nature of ontologies conflicts with the dynamic nature of the world. Businesses often change and need to adapt the semantic representation of their occupations to the changing business environment. Governments, which change less often, still need to adapt their regulations to a global community, while maintaining some divergence from standard governance, reflecting local interpretations and lingual differences. An emergency incident requires collaboration among all these organizations with rescue and support forces within a limited timeframe. The research literature has proposed a hybrid approach, in which ontologies are recognized as static entities yet an organization can change its business semantic representation dynamically. To do so, an ontology is defined to have two parts: a static part (which is the global ontology) and a dynamic part, which evolves either by exporting ontologies or by discovery. With such a model, organizations can still interoperate using the universal part of the ontology and continuously change their business models using the local component of the ontology.

In the quest to identify frameworks, concepts, and models for crisis ontologies the term 'Open Ontology' was addressed in (Di Maio, 2007). 'Open Ontology' refers to a given set of agreed terms, in terms of conceptualization and semantic formalization, that has been developed based on public consultation. Previous efforts to utilize ontology for crisis response include the OpenKnowledge system, which supports and enhances the sharing and effective use of information and services among different actors (Vaccari et. al., 2006). Previous work also focused on blogs and the collaborative tagging approach (Ziesche, 2007). However, the present work takes ontology for crisis management further and enables real-time extension of the ontology.

An ontology-based model for multilingual knowledge management in information systems has been proposed in (Segev and Gal, 2008). The unique feature was a lightweight mechanism, dubbed context, which is associated with ontological concepts and specified in multiple languages. The contexts were used to assist in resolving cross-language and local variation ambiguities.

The technique presented here is different from the previous model since it requires the ability to create and modify the ontology in real-time as the crisis arises and continues to evolve. This requirement necessitates having a basic predefined multilingual ontology while allowing the expansion of the ontology according to the crisis circumstances and the addition of other languages within the crisis time limitations. The technique can be adopted to build an ontology where each concept can be represented in multiple languages and can be expanded for use in crises, such as the Boxing Day Tsunami.

The Sphere handbook (Sphere Project, 2004) is designed for use in disaster response and is applicable in situations where relief is required, including natural disasters and armed conflict. It is designed for use in slow- and rapid-onset situations, rural and urban environments, developing and developed countries, anywhere in the world. Analysis of the Sphere handbook index shows that it meets many requirements of an ontology. Thus, the current index can be defined as an Index Ontology. The Sphere Handbook was translated into 37 languages. Thus it supplies a top level ontology that can be used concurrently in multiple languages. Since each high level Index Ontology concept is represented in multiple languages, there is faster ontology adaptation in crisis situations. A sample of a multilingual ontology in English, French (F), Tamil (T), and Sinhala (S) is presented in Figure 1. In addition, the top level ontology can be expanded according to the specific emergency using additional resources, for example, an index from a relevant book such as a medical manual, or Web sites, such as Wikipedia.

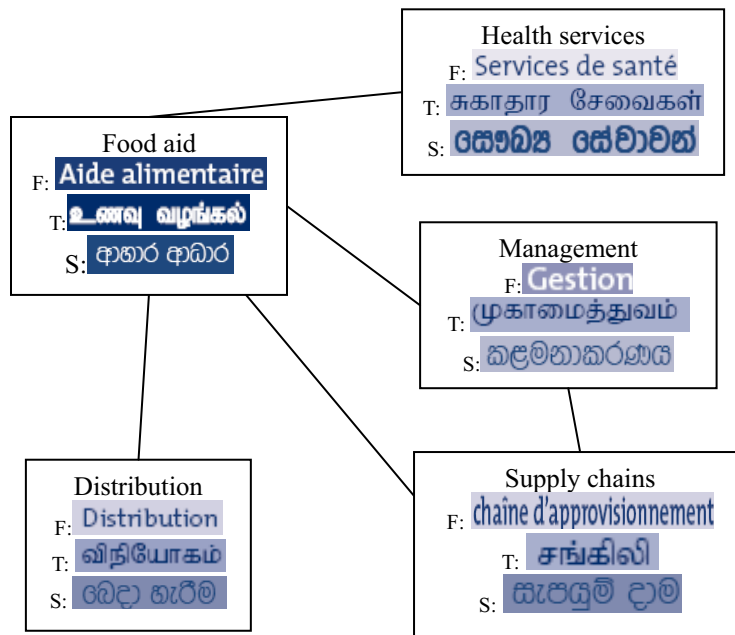


Figure 1. A sample of the extracted multilingual ontology

2. Utilizing the Knowledge Ontology

The question arises of how the Index Ontology can support agencies and groups involved in a crisis. The answer can be divided into two separate tasks: to enable the information flow during the crisis to be matched with relevant ontology concepts and to direct the relevant information to the correct agency or individual. The ontology matching process directs the crisis information flow to the relevant ontological concepts. The crisis might include multiple types of information such as documents, emails, blogs, and update postings in message boards. The Index Ontology can serve as a knowledge base for directing crisis information flow. An information system deployed in a crisis can use the Index Ontology as an immediate knowledge representation that can be accessed by emergency forces. Civilians in a

crisis can access such a system to link to relevant information or to provide real-time information that will be matched immediately with concepts predefined in the ontology. This ontology can be set up in the initial time frame of the crisis allowing information to be sent in multiple languages using the same framework. The example of the Boxing Day Tsunami shows the relevance of such an ontology. For instance, an email or a blog web-site requesting *food aid* in the civilians' local language such as Tamil or Sinhala could be collected with all of the incoming *Food Aid* requests from all of the crisis locations to the relevant concept. Consequently, management teams can make decisions based on the information associated with the *Management* concept and its related concepts (Figure 1).

Experiments are underway to analyze the ability to map relevant crisis information based on the Index Ontology. Blogs posted during the Katrina and South Asia earthquake crises are being used to analyze information flow based on the multilingual ontology. An application which utilizes the ontology is currently being developed based on these postings.

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