An Ontology-Based Framework for Adaptation Relate to Climate Change in Health Perspective Recommendation

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***Abstract*— Climate change endangers human health, affecting all sectors of society, both domestically and globally. The solution for human to help and protect their kind from this issue is to adaptation. This article presents an ontology-base framework for adaptation relate to climate change in health perspective recommendation. In present methodology, researchers have proposed conceptual models for those subjects. In this paper we support the use of ontology to explicitly specify knowledge vocabulary in adaptation relate to climate change in health perspective domain and relations between them. We define three processes that introduce a recommendation system. (1) Ontology Development (2) Knowledge Base Development, the process to gather data about climate change in any location from web space, in this framework we propose micro-blogging: Twitter to make RDF store about climate change events (3) Recommendation, match the information to recommend. Our proposed framework is expected to contribute in the future.**

***Keywords*— Ontology, Web Space Crawling, Recommendation System, Adaptation, Climate Change**

I. INTRODUCTION

There is now strong evidence that the earth's climate is changing rapidly, mainly due to human activities. Increasing temperatures, sea-level rises, changing patterns of precipitation, and more frequent and severe extreme events are expected to have largely adverse effects on key determinants of human health, including clean air and water, sufficient food and adequate shelter. [1] The potential impacts of climate change on human health are significant, ranging from direct effects such as heat stress and flooding, to indirect influences including changes in disease transmission and malnutrition in response to increased competition for crop and water resources. [2] Climate change may be considered as a key factor for environmental change, exposure to health risks and pathogens, consequently impairing the state of health among populations. [3] Climate Change is very serious problem that we are facing today. WHO [4] said 'The world's climate system is an integral part of the complex of life-supporting processes. Climate and weather have always had a powerful impact on human health and well-being. But like other large natural systems, the global climate system is coming under pressure from human activities. Global climate change is, therefore, a newer challenge to ongoing efforts to protect human health.' And WHO [4] also said 'Today, humankind's activities are altering the world's climate. We are increasing the atmospheric concentration of energy-trapping gases, thereby amplifying the natural "greenhouse effect" that makes the Earth habitable. These greenhouse gases (GHGs) comprise, principally, carbon dioxide (mostly from fossil fuel combustion and forest burning), plus other heat-trapping gases such as methane (from irrigated agriculture, animal husbandry and oil extraction), nitrous oxide and various human-made halocarbons.'

Adaptation involves changing the way we do things to prepare for the potential impacts of climate change. This means we will be better protected against negative impacts like flooding. It also means we'll be better prepared for new opportunities, like the chance to grow different crops. [5] Generally adaptation usually be provided by government as policy planning such as United Kingdom. [5] But people can reduce their vulnerability from climate change by themselves in individual level. The question is "How to adapt?" efficient health surveillance systems are required to support adaptation to climate change. [3]

Gruber [6] mentioned 'Ontologies provide a common vocabulary of an area and define-with different levels of formality-the meaning of the terms and the relations between them. Ontologies are usually organized in taxonomies and typically contain modeling primitives such as classes, relations, functions, axioms, and instances'. Noy and McGuinness [7] supported that 'Developing an ontology is akin to defining a set of data and their structure for other programs to use. Problem-solving methods, domain-independent applications, and software agents use ontologies and knowledge-based built from ontologies as data'. Ontology is the tool to create semantic knowledge-based based on Semantic Web technology. [8]

For the information about stream events. We purposed in social web space that has all time update information.

Twitter is an online social networking and microblogging service that enables users to send and read "tweets", which are text messages limited to 140 characters. Registered users can read and post tweets but unregistered users can only read them. Bakshi [9] said Twitter is a popular social media service, with millions of registered users as of December 2010. Twitter hosts substantial amounts of user-contributed data of real-world events. Twitter's core functions represent a simple social awareness stream model. Twitter users share information about upcoming events, the events the users are attending and events being broadcasted. The users also specify their location in their profile on Twitter. So 'information about upcoming events' in twitter is very useful in our framework, to get the up-to-date news or information about disaster or climate change in any location in the world. We can purposed some reliable user like government department or nation news weather to get data from them and create semantic data (see more in conceptual model framework) for recommendation process.

In traditional forms of text comparison, all words in the text are considered. Using an ontology that covers those relations might therefore be useful in recommender system. [10] Recommending adaptation relate to climate change in health perspective can be done by get adaptation solution from expert (in this case, we expected knowledge in some researches). So in this framework we proposed ontology to create semantic data, then the semantic rules are applied for inference data to semantic knowledge-based. We choose the Resource Description Framework or RDF (language for representing information about resources in the World Wide Web) [11] to be the syntax structure of our semantic knowledge-based, after this we will call RDF store. To recommend, user have to query through user interface (In process it is SPARQL query) from RDF store to recommend adaptation method

II. Literature Review

In an ontology-base framework for adaptation relate to climate change in health perspective recommendation. We aim to study knowledge in this subject from researches [1] [2] [3] [12] [13] [14] [15] [16] for preliminary data creation. In this framework we define four-part conceptual model that introduce a recommendation system. (1) Ontology Development (2) Knowledge Base Development (3) Recommender. This section focuses on the study of related works on recommendation systems and web space crawler system.

A. System or application relate to climate change

Now climate change is the popular domain. Many institute relate to climate change on Climate change has create their resource application with knowledge sharing. WHO Collaborating Centre for Research on the Epidemiology of Disasters (CRED) [17] has been maintaining an Emergency Events Database EM-DAT. EM-DAT was created with the initial support of the WHO and the Belgian Government. The main objective of the database is to serve the purposes of humanitarian action at national and international levels. It is an initiative aimed to rationalize decision making for disaster preparedness, as well as providing an objective base for vulnerability assessment and priority setting. So it just database that collect reliable information and can be searched information: by disaster, year and location. Like database on Local Coping Strategies by United Nations (UN) [18] that is intended to facilitate the transfer of long-standing coping strategies/mechanisms, knowledge and experience from communities that have had to adapt to specific hazards or climatic conditions to communities that may just be starting to experience such conditions, as a result of climate change. So this database can be searched by climate hazard, impact or coping strategy, or a combination thereof. But these databases do not have any adaptation in any perspective, but useful knowledge for our research relate to climate change

B. Ontology

Ontology is the semantic technology in semantic web concept that can upgrade knowledge-based to semantic knowledge-based. Gruber [5] defined ontology as the 'An ontology is an explicit specification of a conceptualization'. Ontology is used to clearly describe the concept in a field, the characteristics of properties, attributes, as well as specific restrictions relevant to the concept described. Ontology includes concepts, relationships and instances. [19] [20] [21]

C. Ontology-based systems

Recommendation system requires knowledge-based to fulfill query recommendation. Chen, et, al. [22] present a Diabetes Medication Recommendation system, based on domain ontology. They first build ontology knowledge about the drug's nature attributes, type of dispensing and side effects, and ontology knowledge about patients' symptoms. It then utilizes Semantic Web Rule to induce potential prescriptions for the patients. This system is able to analyze the symptoms of diabetes as well as to select the most appropriate drug from related drugs. Guo and Wu [23] present ontology-based oilfield non-metallic pipe information retrieval system. They built an ontology model that can describe different information of oilfield non-metallic pipe. They conclude by compare ontology-based method with the traditional retrieval method, the domain ontology-based non-metallic pipe information retrieval system can significantly improve the recall and precision rate. It has great advantage and potential in the field of intelligent information retrieval. Nantiruj, et, al. [24] present an E-Health advice system with Thai herb and an ontology. E-Health system provides advices and symptoms treatments using Thai herbs. Their system has three service functions, the Thai herb search, treatment and advice functions. The first two functions are designed using the database query method while the third function uses the Semantic Web technology. They use an ontology to express the relations among provinces, symptoms, anamnesis and Thai herbs. The system provides the recommended Thai herbs to treat some

symptoms based on user and Thai herb data and inference rules. Carrer-Neto, et, al. [25] present social knowledge-based recommender system in movies domain. This system composed of three modules, namely, ontology repository, data collector and the recommender system. IJntema, et, al. [10] present ontology-based news recommendation. They purposed recommending news items using a domain ontology instead of using a term-based approach and concluded with the evaluation that news ontology-based method performs better than the traditional method with the measure (recall).

We observe that ontology is useful for annotate unstructured data (normal data) to be structure data or semantic data, so this literature review proved better to use ontology-based in recommendation system.

D. *Web Space Crawling*

Nonesrichai, et, al. [26] present the development of Twitter message analysis system. They said 'Social network is a community of people in the cyber world. One popular social network is Twitter where people tweet with others to exchange their knowledge, opinions, and experiences.' So they focused on analyzing the Twitter user's behavior and the impact of each user on social network. The system consists of a subsystem for determining the messages which opinions are expressed in and another for analyzing sentiments on messages to check whether the opinion is positive or negative. Boanjak, et, al. [27] present TwitterEcho, an open source Twitter crawler for supporting this kind of research, which is characterized by a modular distributed architecture. They said the crawler enables researchers to continuously collect data from particular user communities, while respecting Twitter's imposed limits. Their evaluation of the system shows high crawling performance and coverage.

We observe that twitter crawler is the method to gather data from twitter. And modular nature of twitter crawler allows researchers too many segments of Twitter data such as name, location and tweet's date or time.

III. CONCEPTUAL MODEL

Fig. 1 shows the conceptual model of an Ontology-Based Framework for Adaptation Relate to Climate Change in Health Perspective Recommendation. We define three processes that introduce a recommendation system.

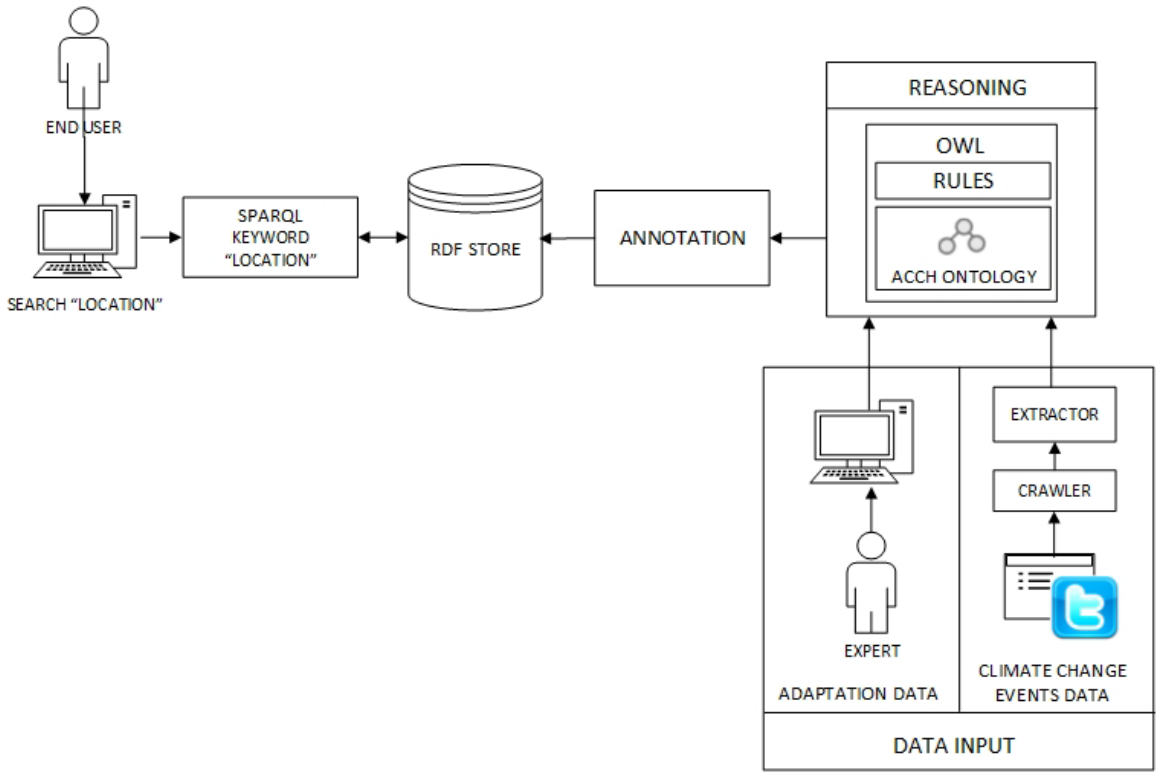

Fig. 1 Conceptual model of an Ontology-Based Framework for Adaptation Relate to Climate Change in Health Perspective Recommendation

A. *Ontology Development*

In building domain ontology process, we extract data from researches which main in A Report Outlining the Research Needs on the Human Health Effects of Climate Change [15] to identify the concept and relation between them. So we use this domain ontology in gather data and create RDF store processes.

B. Knowledge Base Development

To create semantic knowledge-based: RDF store about adaptation solutions in third process. We have to gather data first, so we separate the data into 2 parts: (1) The climate change events data and (2) adaptation data.

1) *The climate change events data:* This process is the automatic process consists of 3 sub-processes.

a) Gather data: This sub-process is gathering data about climate change in any location from web space, in this framework we proposed micro-blogging: Twitter to make RDF store about climate change events. Propose of this sub-process is extract keywords that could present the contents of climate change events from twitter records. We choose named entity recognition (NER), the process of finding mentions of specified things in running text. We choose dictionary-based chunking to finds all matches against a dictionary and give them type and entity recognition by keywords. So it is ready for annotate sub-process.

b) *Annotate and inference:* After system gets required data, this sub-process will annotate and inference data to make semantic data. We use domain ontology to annotate data to semantic data and use semantic rule to inference with reasoner. Semantic rule

c) *Create RDF file:* After annotate all data, system will write data in file and create in RDF store.

2) *Adaptation Data:* In conceptual model, adaptation data in the manual process consist of 3 sub-processes.

a) Get information from expert: Expert in this subject will input data through user interface.

b) Annotate and inference: Then system annotates and inferences data to make semantic data like the climate change events data creation

c) Create RDF file.

3) Recommender: Information to recommend in this process will be retrieved from knowledge-base. This process consists of 2 sub-processes.

a) Query: Users query by location name through user interface. Then process will get input name and translate it in SPARQL query for query in RDF syntax.

b) *Retrive Information:* In SPARQL's term: SPARQL Query Language for RDF. SPARQL is the W3C standard language for querying RDF data.9 A query in this language can be roughly divided in two parts: (i) the retrieval part (body) and (ii) the result construction part (head). [28] , it will match the climate change events information with adaptation information to give the recommender.

IV. CONCLUSIONS

Climate change is very serious problem that impact to any perspective (e.g. infrastructure, settlement, health, and environment) for people in any location in the world. Adaptation involves changing the way we do things to prepare for the potential impacts of climate change.

The purpose of this study is to design an ontology-base framework for adaptation relate to climate change in health perspective recommendation. We adopt the methodology of an ontology model for create semantic knowledge-based. We define three processes that introduce a recommendation system. (1) Ontology Development (2) Knowledge Base Development is the process to gather data about climate change in any location from web space, in this framework we propose micro-blogging: Twitter to make RDF store about climate change events (3) match the information to recommend. The first process we studied about climate change and adaptation that relate to health perspective from researches. We used competency questions to evaluate the relations between entities in ontology. The second process is create RDF store, the semantic knowledge-based. This framework choose Twitter crawler to claw data from Twitter, to create knowledge-based as climate change events knowledge-based. We also purposed named entity recognition to finds all matches keywords, so automatic annotate those data to create semantic data. Also another data is adaptation knowledge-based that manual annotate by expert or administration user. And the last process is recommending process; this process has to match the semantic information from climate change events and adaptation knowledge-based.

Most importantly, we are expecting that this study is very appropriate to many applications in concept of semantic web. And in the scope of adaptation relate to climate change in health perspective, the main contribution is new domain ontology in this subject that can reuse, implement or develop more over. So with this framework that combine 3 process (Ontology Development, Knowledge Base Development and Recommender) any researcher can adapt this process to theirs domain or data resource appropriation.

A future work, we plan to develop the recommender system from this framework. And also develop rule to merging 2 knowledge-based, climate change events knowledge-based with adaptation knowledge-based. Meanwhile, during experimentation, we specify the scope of data collections. But we have been more interested in wider scope, so we have to collects more information for semantic knowledge-based.

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