A Web-based System for Environmental Health Information in a Malaysian Context

Tiu Chung Lau¹, Lee Seldon Henry¹, and Bee Theng Lau²,

¹ School of Engineering, Computing, and Science, Swinburne University of Technology
Sarawak Campus, Kuching, Sarawak, Malaysia
tlau@swinburne.edu.my
¹ Faculty of Information Science & Technology Multimedia University, Melaka, Malaysia
Lee.seldon@mmu.edu.my
² School of Engineering, Computing, and Science, Swinburne University of Technology
Sarawak Campus, Kuching, Sarawak, Malaysia
blau@swinburne.edu.my

Abstract. Customized applications embedded with map interfaces are quite popular now-a-days. Also, the relation of environmental health data to human wellness is being increasingly recognized. In this paper, it proposes a web-based system for collection and targeted distribution of latest alerts and real-time environmental factors to the Malaysian population. It is called as Environmental Health Management System (EHMS). This web-based system is designed to facilitate and encourage research into environmental health quality issues by providing a comprehensive tracking and monitoring tool. This web-based system is embedded with Google Maps API and Geocoding API services to visualize the location and environmental health reports from the aggregated online newspaper and social media news feeds. It introduces the ontology-based model approach and system implementation, system evaluation and discussion of EHMS.

Keywords: environmental health, web-based system, environmental health management system, geocoding API, google maps API.

1 Introduction

The aim of this research is to describe a web based Environmental Health management system for collecting and reporting latest alarm reports and real-time environmental factors surveillance in Malaysia. An outstanding GIS-based EHMS solution can fulfill the task of clustering the spatial and uncharted electronic based sources regarding to Malaysia environmental issues and health effects.

The most prominent environmental challenges in Malaysia at the moment are considered to be air pollution from industrial emissions, solid waste management, ensuring long-term sustainability of the water supply and sewerage services industry and overall improvements of energy efficiency to re-establish a clean Malaysia [1]. These conditions led to continued alarms about environmental issues and potential health effects on the Malaysia population.

© Elsevier, 2012
According to [1] the country’s social and economic transformation has resulted in both positive and negative environmental effects on the health and safety of its people. However, further degradation of the environment will threaten human ability to survive and sustain their life. Hazardous environmental exposure can lead to various health problems; with short-term exposure humans will get choking, coughing, burning eyes and nasal and respiratory irritation; with prolonged exposure to elevated levels humans will get damage to lung tissues, respiratory issues and decreasing lung function; with repeated exposure humans will have a diminished ability to fight the respiratory infections and may link to death of illness.

Environmental health or wellness refers to the health impact of the air human breathe, the water human drink, the homes human live in, the soil growing the food human eat, and the many other environmental hazards, exposure and contaminations that expose to human being in daily lives [2], [3]. Environmental Health study can be referred back to ancient civilizations, and it was common in large towns long before the industrial revolution [4]. Although Malaysia is geographically relatively secure from natural environmental threats, the impact of mass economic development can and has caused environmental health issues which have overtaken the efforts towards environmental protection [1].

According to the World Health Organization [5] and the [6], there are priority environmental issues – siltation caused by agro-based activities, logging and mining, and infrastructure development, deteriorating river water and ground quality, marine pollution, toxic and hazardous waste, solid waste, deforestation and destruction of biodiversity caused by logging and conversion to other land use, rapid growth in water demand, more efficient use of energy required, coastal pollution, trans-boundary air pollution. All these environmental health issues have been identified and acknowledged to be important in Malaysia based on the latest data sheet in World Health Organization environmental health country report [5] and the Malaysia environmental quality report in 2009 [6].

2 The Ontology-based Model and System Architecture

The environmental health ontology model represents as environmental health keywords in taxonomy. The ontology model development has referenced to the existing environmental health ontologies from various ontological models or existing surveillance systems as referred to [3], [7], [8], [9], and [10]. The Ontology-based modeling approach [11], [12] is proposed to support the design of EHMS. It is the most promising approach, as it enables a formal analysis of the domain knowledge, promoting contextual knowledge sharing and reuse in a ubiquitous computing system, and context reasoning based on semantic web technologies [13].

Fig. 1 shows the EHMS’s system architecture with Web Frontend access, Process, and News Feed Source. In Web Frontend, the web page with Google map, search features of environmental health topic categories, online media news categories, date, location, and news title will be loaded in user’s browser.
The user can search by location, environmental health topic categories, news title, web sources, and date in order to find the latest report that contains environmental health issues. The users are able to add news, which is approved by administrator. The users are given opportunity to bookmark, share and even comment via the social media networks.

In Process, this level is where it handles user request from Web Frontend, data acquire from news feed sources, and text classifications. The request from user will be received and converted into a database query it would return the alarm reports that match these queries. Data acquisition allocates 7 main fields from News Feed Source: title, link, description, location, and date. The parsing process involves extracting the elements from the documents that is useful. The Classification engine decides the primary locations and environmental data (exposure, hazard, and health) associated with each report acquired from web sources. The classification engine has two modules that process the raw input and final output, which are the Reader module and Parser module. Reader module uses multi-tier architecture, also known as N-tier approach [14] as a classifier to identify location and Environmental Health Data for each web sources and Geocoding web services will later generate coordinates for the identified location. In general, the Classifier will examine every sentence and paragraph in the reports in order to match location name and Environmental Health categories against existing taxonomy of known patterns. Parser module uses a word-level N-gram approach [15], [16] to match input against dictionary of known patterns. After the initial data acquisition, the parser will extract the input into characters and compares to the dictionary of place and environmental health ontology, mapping text patterns to the database IDs of all locations, environmental health categories, possible reactions and environmental dimensions known to the system.

In News Feed Source, when the web sources are extracted with location and environmental health data, the system stores them in a relational database (MySQL). User Request handling is to process any request from public users. System request handling is to process internal request by the system.
3 Implementation

EHMS has been implemented fully in this research, some of the user interfaces are shown below. In Fig. 2 (A), the web frontend access is shown, which enables public users to check the latest environmental health alerts on Google Maps and by clicking on “balloon” marker to view the results at the specific location. In Fig. 2 (B) public users can view more details, bookmark and share through social media networks, and leave a comment at that particular environmental health alert. In Fig. 2 (C), the search features are shown which enable public users to search by news title, online media news source, environmental health topic, location name, and date. In Fig. 2 (D), public users are able to submit any news that is relevant to environmental health topic but which was not captured by the system itself. The submission will be verified and approved by the administrator of the system.

![Environmental Health Management System (EHMS)](image)

Fig. 2 The Environmental Health Management System (EHMS)

4 Evaluation and Discussion

An evaluation has been conducted on the system by manually evaluating the input for accuracy purpose, and the taxonomy of keywords was refined to increase the accuracy of database entries. Table 1 shows a sample on how the evaluation test was initially conducted.
Table 1. Comparison before and after keywords refinery.

<table>
<thead>
<tr>
<th>Before keywords refinery</th>
<th>After keywords refinery</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Keywords</strong></td>
<td><strong>No. return ed results</strong></td>
</tr>
<tr>
<td>Floods</td>
<td>25</td>
</tr>
<tr>
<td>Lead</td>
<td>8</td>
</tr>
<tr>
<td>Diesel Spill</td>
<td>0</td>
</tr>
<tr>
<td>Mosquito</td>
<td>0</td>
</tr>
<tr>
<td>H1N1</td>
<td>0</td>
</tr>
<tr>
<td>Avian influenza</td>
<td>0</td>
</tr>
</tbody>
</table>

In Table 1, it shows the comparison of before/after keyword is refined in term of the number returned results and the number of relevant results. It shows the improvement of more relevant results returned when the existing keywords are provided with alternate vocabularies; otherwise, it could lead to more irrelevant and junk news due to high levels of irrelevant news patterns in web sources. The current solution is to define a comprehensive taxonomy by integrating more existing ontologies from other vendors as they may help to refine keywords with alternate vocabularies in their ontologies.

When there is a strong evidence of a link between environmental hazardous and adverse effects on human reproductive health [17], in other word, this scenario can be also treated as how this system can serve as a healthcare tool to receive the latest alert of environmental health issues outbreak nearby the area [10] and assist general public.

In fact, one could possibly reverse-engineer the search method on health symptom and sign to find out the latest environmental health outbreak that may build related adverse effects, through web-based tool like WebMD symptom checker [18]. Due to environmental health issues serve as one of the highly concerned healthcare topics, this research leverages the feasibility and the scope of environmental health studies becoming much more public-oriented and transparent in the near future.

5 Conclusion and Future Work

The analysis, design and implementation of EHMS for the Malaysian context have been described. In this research, it has designed an environmental health ontological model for EHMS. In this paper, it presents the proposed EHMS, which is enhanced by
integrating existing models, databases, web-based tools, and GIS technology. The various stages have been discussed to show the overall development of EHMS. To date, there is no similar EHMS for Malaysian context, so the evaluation will continue on searching efficiency testing and effectiveness of the system to assist general public. Subsequently, the environmental health ontology model will be enhanced. Moreover, a mobile based application will be developed to support more ubiquitous access of EHMS users.

References

3. Environmental Health Investigation, Branch California, http://www.ehib.org/project.jsp?project_key=EHSS01