The Decision Support System for Health Check Booking Based on Semantic Model

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Abstract **- The Decision Support System provide clinicians, staff, patients, and other individuals with insight information that can intelligently filtered and support the decision effectively. In this paper, we develop a decision support system for health check booking based on semantic model to improve health and health care services. Our model corresponds to clients' keywords by using Web Ontology Language (OWL) Processing. Ontology Concepts, Properties, and Relationships are used as retrieval mechanisms for best booking program selection. Additionally, a new model can reduce the possibility of the incorrect retrieval results on related keywords. Finally, we evaluate our model and present our results at precision 93.8% and recall at 86.8% respectively.**

Keywords **- Ontology, Decision Support, Health Check, Semantic Model**

I. INTRODUCTION

In healthcare domain, decision support systems (DSSs) are also commonly known as Clinical Decision Support System (CDSS) [1]. DSS is defined as "an interactive, flexible and adaptable computer-based information system" and is developed to provide solution for non- structured management problem [2]. DSS utilizes data, provides an easy-to-use interface and allows for an individual patient are matched to a computerized clinical knowledge base and patient-specific assessment or health check program recommendations are then presented to the clinical or the patient for a decision" [3].

The major advantage of DSS is that it helps to improve patient care and efficiency of the healthcare providers [4]. "Act of providing clinicians, patients and other health care stakeholders with pertinent knowledge and/or person-specific information, intelligently filtered or presented at appropriate times, to enhance health and health care." In fact, several studies have shown similar focus and apply for decision support that reduce medication errors, and promote preventive screening and use of health check-based program recommendations for medication booking reservations [5].

Nowadays, DSS primary is being considered to improve overall efficiency, identify disease early, aid in accurate diagnosis or protocol-based treatment, or prevent dangerous adverse events affecting the patient. Moreover, DSS is a key decision to solve problems identified the needs of appropriated program schedulers for example, matching the qualifications of doctors or clinician with patients who need special health check programs. The information from the DSS can be retrieved automatically to the patients or "on demand" (i.e., when the patients chooses to query the information) [6, 7]. Whatever the features of DSS delivery of information, the quality of the information and the evidence underlying it are the major determinants of the impact of DSS on patient safety availability, and quality improvement.

In this paper, we propose Decision Support System for Health Check Booking based on semantic model. We adopt ontology concepts and semantic features, through a given condition, to suggestion that take into account

a patient's specific requirements. Our model can recommend and customize order sets of Health Check booking program, a program for combining that knowledge with patient-specific information, and a communication mechanism.

Our paper is organized by followings: Section 1 Introduction, Section 2 discusses literature reviews of related works, Section 3 discusses about the problem overview, Our OMNN-IMAGE model and the experimental results are provided in Section 4 and 5 respectively. Finally, a conclusion is given in section 6 with future works for next generations.

II. LITERATURE REVIEW

Ontology is originally the philosophical concept of a systematic explanation of being. In recent years, however, this concept has been introduced to and used in different contexts, thereby coming to play a predominant role in knowledge engineering and in artificial intelligence [8]. According to Mizoguchi [9], Ontology provides a common vocabulary, and an explication of what has been often left implicit". Later on, Gruber, in the context of knowledge sharing, used the term to refer to an explicit specification of a conceptualization [10, 11]. Ontology engineering has contributed several aspects to modeling.

In this paper, Ontologies are in conceptually organized as trees in sematic model. Each internal nodes of the tree represent ontology concepts which can tag the semantic meanings on the web. It is defined as O {C, P, I, R}; C = Ontology concepts, P = Properties, I = Instance, and R = Relationship [12].

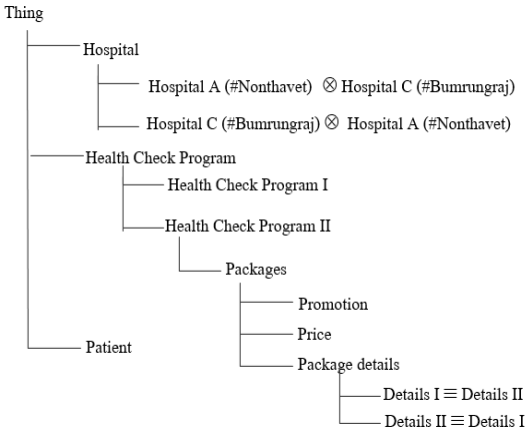

Fig. 1 The Excerpts of Health Check Ontology

To match the meaning among heterogeneous ontologies, ontology mapping aims at finding correspondences between semantically related entities of different ontologies [12]. In terminology, a correspondence or a mapping m is defined as a four-tuples of the form: m = (e, e', r, k) where: e and e' are entities in ontologies O and O' respectively, r is a kind of relation (e.g., equivalent, subsume) and k ∈ (0, 1) represents the similarity value of entities [8].

If r is an equivalent relation, then we can call a pair of entities e and e' a match. For example, ontology mapping between O_A (Patient) defined as O_A is a source ontology, and O_B (Hospital) defined as O_B is a target ontology is shown in Fig. 2.

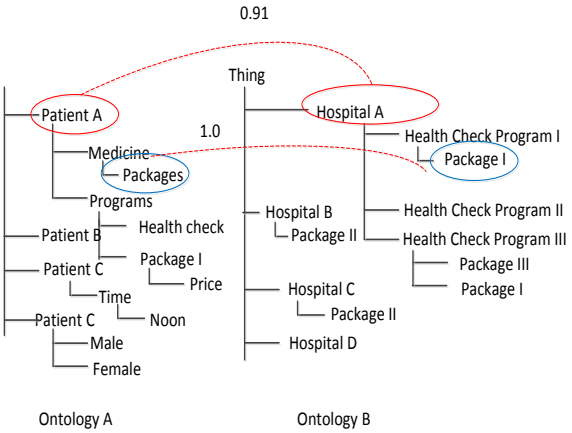

Fig. 2 The Similarity Matching Model Using Ontology Mapping

To calculate the semantic correspondences between similar entities of heterogeneous

ontologies, we use Levenshtein method (It is also called "String Similarity") [12]. The method can be computed at the level of letters, words, or phrases of concept names (C_1 and C_2). The similarity is calculated in Eq. (1).

$$\text{Sting Similarity } (C_1,C_2) = 1/(1+\text{editDist } (C_1,C_2)) \quad (1)$$

Generally, the string similarity value is defined in the range of (0,1) where the lowest value 0 (zero) = dissimilarity, the highest value 1 = exact matching, and others are in between 0 and 1 [12]. In this paper, we the similarity value setup baseline is at above 0.8.

III. PROPOSED MODEL

The developed model represents Ontology as tool to represent and retrieve knowledge. As defined by Gruber [8], Ontology is a formal description of the domain concepts and the relation between Concepts, Properties, and Relations. Therefore, Ontologies can be measured and paired between their Concepts considering the semantic relationship between Concepts' similarity [12].

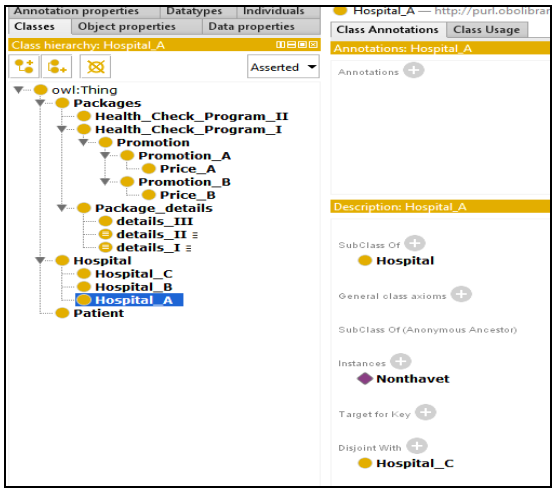

Fig. 3 The Development of Health Check Knowledge Based on Semantic Model

In this paper, Ontology is typically retrieved from the health check knowledge based on semantic model, and it is calculated for semantic similarity value of paired Concepts between patients and their health check programs when performs program selections in Table I.

TABLE I
THE RESULTS OF SEMANTIC RELATOINSHIP BETWEEN PAI RED ONTOLOGY CONCEPTS

Paired Concepts	String Similarity Value
Patient A, Help check Program I	0.91
Patient A, Help check Program II	0.31
Help check Program I, Hospital A	0.87
Help check Program II, Hospital A	0.25
Patient A, Hospital A	0.72
Patient A, Hospital B	0.31
Help check Program I, Hospital B	0.01

The query mechanisms are web services' agents connecting to JENA interface to communicate between users and their target health check information in knowledge based on semantic model (Fig. 4). To query health check information, it will determine a set of paired Concepts that could be matched with similar Properties and Concepts' names in Target ontologies. (i.e., Concept name "Patient A" matched with Health check program I, and related to Hospital A which the similarity values are above baseline value (0.8) at 1.00 and 0.91 respectively).

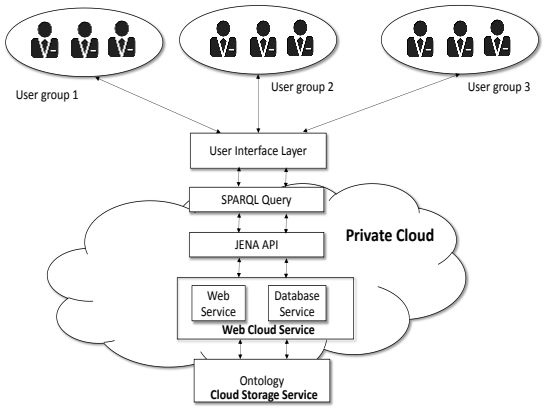

Fig. 4 The Decision Support System for Health Check Booking Based on Semantic Model

After query completion, an ontology concept which represents the right object class will be given with the information of Patient linkages to point their health check information in knowledge database, and it therefore will be stored a Uniform Resource Identifier (URI) as the annotations.

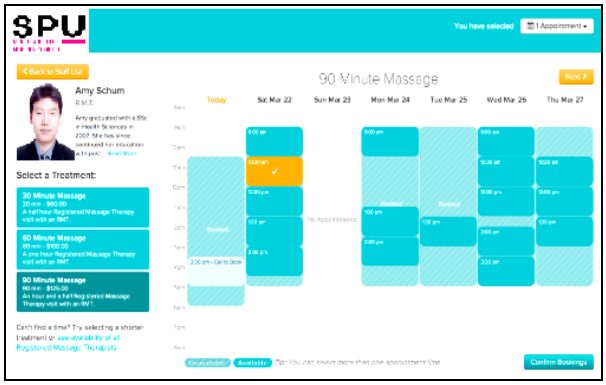

Fig. 5 The Model of Image Retrieval in Semantic Cloud

IV. THE EVALUATION

In evaluation, precision and recall are used in our model to measure retrieval performance (Table II). Precision is defined as the ratio of the number of relevant images retrieved (Nr) to the number of total retrieved images (K). Recall (Re) is defined as the number of retrieved relevant images (Nr) over the total number of relevant images available in the database (Nt).

TABLE II
THE RESULTS OF MODEL PERFORMANCE

No.	Categories	Precision	Recall
1	Patient	95.5%	89.5%
2	Hospitals	94.7%	83.7%
3	Promotion Packages	91.2%	87.2%
Overall Performance		**93.8%**	**86.8%**

V. CONCLUSIONS

In this paper, we propose The Decision Support System for Health Check Booking Based on Semantic Model (Fig. 5). Our model adopts a Semantic Web technology to perform information retrieval. The semantic model for defining and delimiting the use of explicit criteria is suitable for matching clinical information with patients' keywords, as well as it implicitly can address the meanings through the use of concept names and contents appearing in data properties. For example, patients who have never known health check information still can get recommendation from model mechanisms that suggest relevant health check packages. Later, Patients can find out specific programs to make their decision makings. Finally, the performance of the model is evaluated by measuring in the highest precision and recall at 93.8% and 86.8% respectively. Our future work is to improve the scalability and mobility of the model.

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(Arranged in the order of citation in the same fashion as the case of Footnotes.)

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