Brain Cancer Ontology Construction

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Abstract. An ontology is an integral part of a semantic web. Ontology can be designed and create the necessary metadata elements to develop a semantic web applications. The evolution of semantic web has encouraged creation of ontologies in many domains. This work aims to create an ontology of brain cancer to do this we need to define the steps of creation of an ontology; first, we need a lot of information about brain cancer. This article describes the different steps involved in creating a brain cancer ontology. We have used a Protege 4. 2 to for the construction of a brain cancer ontology.

Keywords: Semantic web · Ontology · Protege · Brain cancer · Owl

1 Introduction

The semantic web aimed to enable a much sophisticated management system by organizing knowledge in conceptual spaces using automated tools [1]. The idea of the semantic web is to present web content in a form that is easier to use for machine processes, and to intelligent take advantage of this rendering. To represent information in a form that can be interpreted syntactically and semantically with the computer, we use ontologies in the semantic web. Ontologies have a hierarchical structure of terms that describe a domain that can be used as the basis for a knowledge base [2, 3]. In this article, we have shown a method of ontological construction for brain cancer using protégé 4.2. The ontology of brain cancer can be used as a guide to understanding how brain cancer works. We have shown that brain cancer works with different classes. The different steps involved in creating a brain cancer ontology are described in the fourth part.

The newspaper was divided into five sections. The introductory section provides an initial discussion of some aspects of the paper, such as its purpose, scope, methodology, and system design: a description of Brain Cancer Ontology. It also deals with the search techniques within the knowledge base; there have also been discussions about integration with an ontological browser, which is technically known in information science as a faceted web browser. The final section presents the results achieved during the various stages of ontological construction, along with provisions for future work.

2 Literature Review

Many studies based on artificial intelligence and knowledges share has been developed to help physician understanding and improving the diagnosis results in several medical

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fields, such as brain cancer [4], breast cancer [5, 6], diabetic retinopathies [7, 8], etc. In this section, we are focusing of brain cancer previous work. Several studies have been performed on the detection of brain tumors, and different researchers have raised different ideas based on their opinions and methods used to detect them, so that a diversified conclusion about this disease and its causes and remedies can be achieved. Different techniques are currently used that are based on neural network, Convolutional Neural Network CNN is then used to group and segment the images and finally to detect the cancer [9]. [10] have come up with an improved implementation of Brain tumor detection, segmentation, and classification are three processes that can be used to produce computer-aided methods for diagnosing tumors from magnetic resonance imaging. Diagnosis by means of MRI and MRS is the most important way to detect brain tumors. MRI in Morocco is an expensive affair. Brain scans using magnetic resonance imaging, computed tomography, as well as other imaging modalities, are fast and safer methods for tumor detection [11].

Our developed ontology will primarily benefit physicians and researchers, but its main purpose is to assist novice neurosurgeons. By introducing the symptoms into the system, surgeons may be able to recover the information corresponding to a particular disease. In addition, the system can also help these physicians identify the disease and consider available treatments. Our system is smartly equipped to show possible medical options available for the disease in question.

3 Purpose

The objective of this work is the construction of an information retrieval system based on ontology. To create this ontology, information has been obtained from a wide variety of information sources in the brain cancer literature. This collected information has been analysed to provide a standard, reliable and relevant information base for our proposed system.

4 Methodology

We will see in this section the different steps of the construction [12] of an ontology that we would like to create [13]. However, before creating our domain ontology, we need to have an idea of what ontology can deal with:

- Which doctors have specialized knowledge about brain cancer, and in which hospitals are they available?
- What are the different symptoms of brain cancer?
- What types of brain cancer?
- What are the different hospitals in the country specialized in the treatment of brain cancer?
- Who are the brain cancer specialists in Morocco?
- Which brain cancer are most common in men and women between the ages of 40 and 70?

4.1 Problems of Current Information Retrieval Systems

The various search engines rely mainly on keyword research mechanisms. The results retrieved in this way will show all documents wherever that particular term appears many unnecessary documents are retrieved [14]. For example, someone looking for information on a hospital specializing in the treatment of brain cancer in flap, he will have a lot of useful and useless information. For this, we have tried to develop an information search system based on an ontology.

4.2 Steps of Building Ontology

Step 1 Identification of Terminology: We have relied for our work on technical terms that have been collected from various sources published by different brain cancer associations. We have selected "about brain cancer: a primer for patients and caregivers" by the American Brain cancer Association®, as main sources. The American Association of Neurological Surgeons (AANS) has also taken terms from a classification.

Step 2 Analysis: The formal concepts collected in the previous step were analysed to identify their commonalities and differences. They were also analysed to identify the concepts that will serve as an instance, category or property. Than these terms have been used as basic elements to construct a brain cancer ontology.

Step 3 Synthesis: The synthesis involves the order of the facets according to their similarity in the properties and the labelling of the categories. After the division into classes, they were organized in hierarchical order. Step 4 standardization;

Brain cancer types

- Primary brain cancer
- Secondary brain cancer

Brain cancer cause

- Environmental cause
- Genetic cause

Step 4 Standardization: Aims to conceptualize the results of the previous step. The terms to be kept are defined according to their context and from a definition in natural language. The concepts are then identified as well as the semantic relationships between them. They are alike in the form of a semantic network.

For our work, we have standardized terms from SNOMED CT®.

Step 5 Ordering: The order of the terms should be based on the purpose, scope, and object of the ontology. We have organized a brain cancer class according to the AANS classification system. One limitation is that in our work we only have standardized terms that were used to construct a brain cancer type classes in addition to SNOMEDCT®.

4.3 Brain Cancer Ontology Using the Concept DERA

DERA is a faceted [15, 16]. Knowledge organization framework (Domain, Entity, Relation and Attribute). Domains consist of three elements in DERA [17], namely entity (E), attribute (A) and relation (R). Then we will describe the ontology of brain cancer from the DERA point of view. In this ontology, brain cancer is a domain that contains a class, the relationship between classes or objects, and the attribute or property.. Entity is an elementary component consisting of facets built of classes and their instances, having either perceptual correlates or only conceptual existence within a domain in context. An example of entity class:

- Glioma
- Glioblastoma
- Anaplastic astrocytoma
- Oligodendroglioma
- Ependymoma
- Ganglioglioma

Relation is an elementary component consisting of facets built of classes representing the relation between entities. An example of Relation: Doctors brain cancer specialize, in which hospital they are available. Attribute is an elementary component consisting of facets built of classes denoting the qualitative/ quantitative or descriptive properties of entities.

Table 1. Glossary of terms

Term name	Description
Brain cancer	A tumor lesion that develops in the skull
Glioma	These are the most well-known cancers, so called because the damaged cell is the glial cell, which is found around neurons
Glioblastoma	This is grade IV gliomas, it is the most aggressive and the most common
Chordomas	Originating in embryonic cells of the spinal cord or the base of the cranial nerve
Hemangioblastomas	That originate in the blood vessels
Meningiomas	Beginning in the membrane covering the brain
Hospital	An institution where the sick or injured are given medical or surgical care
Benign Tumor	Are abnormal accumulations of cells that multiply slowly and usually remain isolated from the surrounding normal brain tissue
Patient	Sick person

We describe some terms on which on which we are based (Table 1) to arrive at the construction of the ontology.

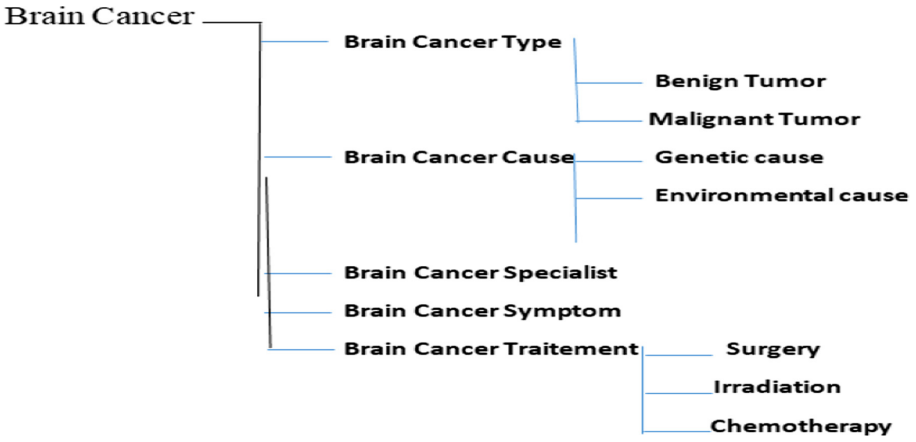

Fig. 1. Concept hierarchies.

A partition of a concept C is the set of subclasses of C, which do not share instances and cover C. Figure 1 represents the hierarchy of the concepts of our ontology.

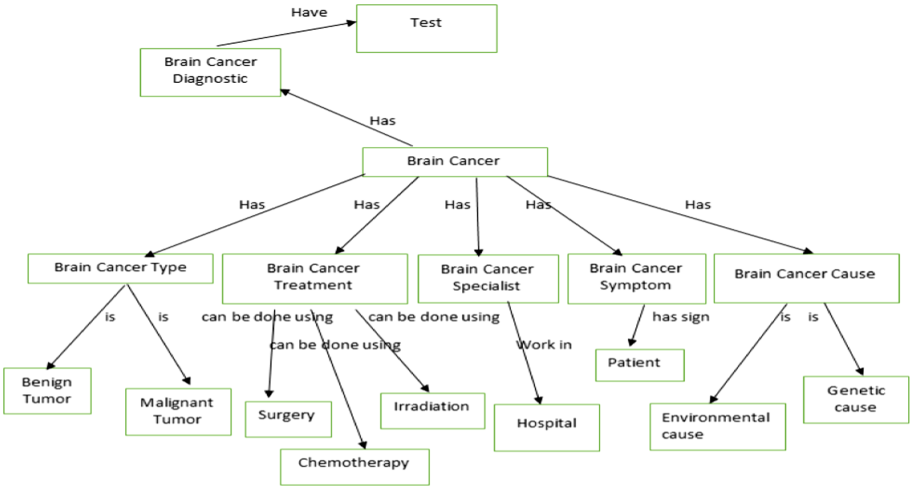

Fig. 2. Diagram of binary relations.

We describe the binary relationships between the source concepts and the target concepts with their cardinalities (Table 2), if we consider Brain cancer as a source concept and Brain cancer diagnostic as a target concept (Fig. 2) we will have a source cardinality of 0.n and target cardinality from 1.1 as shown in Table 2.

Table 2. Table of relationship

Name of relationship	Source concept	Target concept	Source card	Target card
Has	Brain Cancer	Brain Cancer Diagnostic	**0..n**	**1..1**
Has	Brain Cancer	Brain Cancer Specialist	**0..n**	**1..n**
Is	Brain Cancer Type	Malignant Tumor	**1..1**	**1..1**
can be done using	Brain Cancer Treatment	Surgery	**0..1**	**0..1**
Have	Brain Cancer Type	Brain Cancer Symptom	**1..n**	**0..n**
specialist	Brain Cancer Specialist	Brain Cancer Type	**1..n**	**1..n**
Causedby	Brain Cancer Type	Brain Cancer Cause	**0..n**	**0..n**
Consult	Patient	Brain Cancer Specialist	**0..n**	**0..n**
Do	Patient	Test	**1..n**	**1..n**

Table 3. The table of concept instances

Concept	Instance	Attribute
Benign Tumor	Chordomas	Name
Benign Tumor	Meningiomas	Name
Benign Tumor	Hemangioblastomas	Name
Malignant Tumor	Glioma	Name
Brain Cancer Specialist	Dr.LAZRAK Hicham	Name
Hospital	MedV	Name

Table 3 represents some instances of the concepts and the type of each attribute (Fig. 3).

By clicking on OWLVIZ for visualization, class and subclasses appear, and dot error may be found. The solution to this problem is to install Graphiviz 2.28 (Window). Then, in the Protégé 4.2 File (tab) preferences, OWLVIZ, a dot application, add the absolute path where this “dot.exe” file is located, e.g. in case Windows OS (C: \programFile\Graphviz2.28 \bin\dot.exe). The validity of the ontology was confirmed by matching the inferred and asserted ontology as shown in Fig. 4.

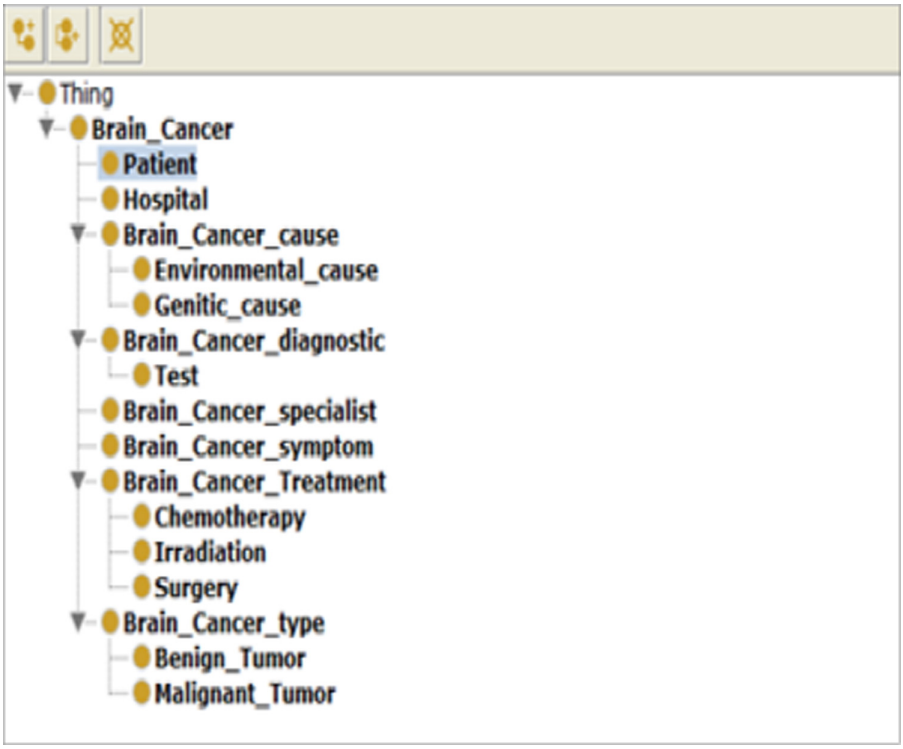

Fig. 3. Brain cancer ontology class hierarchy.

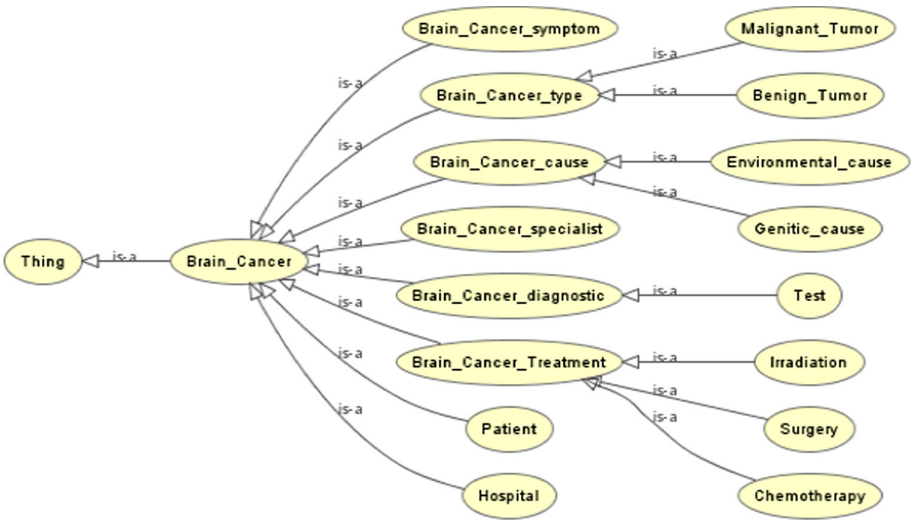

Fig. 4. Visualization of ontology.

```
<Ontology xmlns="http://www.w3.org/2002/07/owl#"
  xml:base="http://www.semanticweb.org/fatih/ontologies/2021/1/untitled-ontology-7"
  xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema#"
  xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
 xmlns:xml="http://www.w3.org/XML/1998/namespace"
 ontologyIRI="http://www.semanticweb.org/fatih/ontologies/2021/1/untitled-ontology-7">
<Prefix name="" IRI="http://www.semanticweb.org/fatih/ontologies/2021/1/untitled-ontology-7#"/>
 <Prefix name="owl" IRI="http://www.w3.org/2002/07/owl#"/>
 <Prefix name="rdf" IRI="http://www.w3.org/1999/02/22-rdf-syntax-ns#"/>
 <Prefix name="xsd" IRI="http://www.w3.org/2001/XMLSchema#"/>
<Prefix name="rdfs" IRI="http://www.w3.org/2000/01/rdf-schema#"/>
<Declaration>
<Class IRI="#Benign_Tumor"/>
   </Declaration>
      <Declaration>
 <Class IRI="#Brain_Cancer"/>
  </Declaration>
 <Declaration>
<Class IRI="#Brain_Cancer_Treatment"/>
</Declaration>
```

Fig. 5. Brain Cancer ontology.

The RDF OWL code generated for classes is shown in in Fig. 5 show the code generated for object properties.

5 Conclusion and Future Work

Presenting active information about brain cancer is very important and very helpful. The computer-based brain cancer ontology supports the work of researchers in gathering data from brain cancer research and provides users around the world with intelligent access to new scientific information quickly and efficiently. Shared information improves the efficiency and effectiveness of research because it helps to avoid unnecessary redundancies in research and thus avoid duplication of work.

Our ontology facilitates the exact combination of genetic and environmental factors as well as their individual impact on brain cancer. We wish to build ontology for a specific disease with a very high mortality rate and gather data on the best hospitals that offer specialized hospitals. Our vision is to create an information retrieval system (which should be able to retrieve all the answers) and at the same time act as a semantic search engine in the developed ontology. This ontology helps to design all new medical professionals as well as lay people looking for information.

We have reviewed the method used to develop ontology; while in future work we will put concrete and real data from the case of Morocco for the creation and sharing of knowledge in the form of ontology for the diagnostic of Brain cancer.

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