|  |
| --- |
| University of Manchester  School of Computer Science  Degree Program of Advanced Computer Science |
| “The Manchester Sushi Finder”  Hani Al Abbas |
| A dissertation submitted to The University of Manchester for the degree of Master of Science in the Faculty of Engineering and Physical Sciences |
| Master’s Thesis  2014 |

Table of Contents

LIST OF ABBREVIATIONS 3

LIST OF TABLES 4

LIST OF FIGURES 5

ABSTRACT 6

DECLARATION 8

INTELLECTUAL PROPERTY STATEMENT 9

ACKNOWLEDGMENT 11

INTRODUCTION 13

Motivation 13

Aims 15

Objectives 15

Contributions of this Project 16

Structure of the Dissertation 16

BACKGROUND 17

OWL 17

OWLClasses 17

OWLObjectProperties 17

OWLDataProperties 17

OWLAnnotationProperties 17

OWL API 17

Conventional Information Retrievial Mehtod 17

Ontology Based User Interface 17

Faceted Based Search 17

Ontology Visual Querying 17

The Manchester Pizza Finder 17

Words Count:

# LIST OF ABBREVIATIONS

|  |  |
| --- | --- |
| AI | Artificial Intelligent |
| API | Application Programming Interface |
| HTTP | Hypertext Transfer Protocol |
| KR | Knowledge Representation |
| OWL | Web Ontology Language |
| RDF | Resource Description Framework |
| UI | User Interface |
| UML | Unified Modeling Language |
| XML | Extensible Markup Language |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

# LIST OF TABLES

# LIST OF FIGURES

# ABSTRACT

This project is designed to show the benefits of using applications, which are ontology driven, in term of browsing and querying for information. It demonstrates the use of the represented knowledge between machines instead of sharing just raw data. Since, the web full of raw information that could or could not has relevancy with each other, OWL ontology language came to represent the knowledge of domains instead of raw data. OWL simulates the intelligence behind the reasoning process in addition to knowledge representation. By doing this, relations between different objects within a domain are represented as well.

Browsing and querying are two of the main characteristics of a retrieval system. Usually, user tries to figure out the functionalities of a user interface or some instructions are provided to guide the user. As for querying, in conventional querying system that is keywords based rather than the underlying concept, the process of retrieving information depends on recalling specific keywords. This method suffers some issues like the recall of keywords and ambiguity in the search query formation process.

Those issues can be reduced be adopting ontology-based method and faceted-based search mechanism. Representing knowledge within ontologies will drive the interface and take care of guiding the user toward building only valid search queries. The recall problem will be reduced since user does not have to remember keywords and all relevant query elements derived automatically from the ontology. As for ambiguity, faceted-based search is introduced to narrow and personalize the search result.

This project is based on existing application (The Manchester Pizza Finder) that is ontology driven interface. An application is built using the code of Manchester Pizza Finder and adding some new modifications and functionalities. The Manchester Pizza Finder is a tool that display a list of toppings based on pizza ontology. The user query for different pizzas based on included and excluded chosen toppings. This project takes this tool further by adding more functionalities and a number of enhancements such as make it dynamically configured based on the ontology used, and implementing filters to be applied on the constructed query and on the search result. The application has the same basic functionalities with the Manchester Pizza finder and it is called The Manchester Sushi Finder that is a tool to query for sushi based on included and excluded ingredients. Although, the main ontology used is based on a sushi menu restaurant, does not mean only sushi ontology will work. In the contrary, a part of making the tool flexible is to allow it to work with different ontologies and domains.

…

…

# DECLARATION

No portion of the work referred to in the dissertation has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

# INTELLECTUAL PROPERTY STATEMENT

1. The author of this dissertation (including any appendices and/or schedules to this dissertation) owns certain copyright or related rights in it (the “Copyright”) and s/he has given The University of Manchester certain rights to use such Copyright, including for administrative purposes.
2. Copies of this dissertation, either in full or in extracts and whether in hard or electronic copy, may be made only in accordance with the Copyright, Designs and Patents Act 1988 (as amended) and regulations issued under it or, where appropriate, in accordance with licensing agreements which the University has entered into. This page must form part of any such copies made.
3. The ownership of certain Copyright, patents, designs, trade marks and other intellectual property (the “Intellectual Property”) and any reproductions of copyright works in the dissertation, for example graphs and tables (“Reproductions”), which may be described in this dissertation, may not be owned by the author and may be owned by third parties. Such Intellectual Property and Reproductions cannot and must not be made available for use without the prior written permission of the owner(s) of the relevant Intellectual Property and/or Reproductions.
4. Further information on the conditions under which disclosure, publication and commercialisation of this dissertation, the Copyright and any Intellectual Property and/or Reproductions described in it may take place is available in the University IP Policy (see <http://documents.manchester.ac.uk/display.aspx?DocID=487>), in any relevant Dissertation restriction declarations deposited in the University Library, The University Library’s regulations (see <http://www.manchester.ac.uk/library/aboutus/regulations>) and in The University’s Guidance for the Presentation of Dissertations.

# ACKNOWLEDGMENT

# INTRODUCTION

## Motivation

As the trend nowadays to try making machines more intelligent [1], sharing knowledge of information instead of sharing the raw data in the web is becoming more desirable. Thinking computers that are able to able to understand, sharing knowledge and simulate the reasoning process of human would seems an idea from Artificial Intelligent (AI) fiction movie. Semantic web is helping in converting the current web of information into a web of knowledge. It is all about sharing knowledge, which is understandable for machines, on the web. Knowledge of a concept domain is been captured and represented according to our understanding within a file called ontology. Ontologies are considered the main pillar of the semantic web. Computers do not understand information stored on the web such as Extensible Markup Language (XML) and Hypertext Transfer Protocol (HTML). They are just codes to the machines and they display it to users regardless of what knowledge needed. So, Sematic web came along for machines to make sense of retrieved information. Ontologies are used to represent knowledge and make inferences from that knowledge using machines computational capabilities and some reasoning techniques such as description logics.

An intelligent way of representing knowledge needs an intelligent way of browsing and retrieving it. There are a lot of intelligent browsers that is ontology driven user interfaces such as Transparent Access to Multiple Bioinformatics Information Sources (TAMBIS) [2], Semantic Webs and AgentS in Integrated Economies (SEWASIE) [3], and the Manchester Pizza Finder [4]. Browsing and constructing queries through such user interfaces would be easy and it will save time, due to the fact that the UI acts as an interactive manual. It eases the process of constructing the intended query since the process itself is guided be the UI. In addition, it saves the user time by displaying only what is the system intended to do. The user does not need to have previous knowledge about the domain, because the explicit display of the options of constructing a query. Ideas like manuals and the help menu in the menu bar of a UI would seem absolute comparing to the self-guided UI. Additional technique to make the UI smart is to user faceted browsing. The idea behind faceted browsing is to personalize the search and get more specific results by suggesting some filters. Faceted browsing is very related to ontology driven UI since both provide some information about the query while been constructed [5].

There are some systems, that are ontology driven UI, exist such as TAMBIS and SEWASIE. TAMBIS is a system that gather and analysis bioinformatics information from different sources through one interactive UI. While SEWASIE meant to access multiple sources of data and help user through out constructing the exact needed query.

The idea of ontology driven UI is not new. In this project, will try to build an application on the top of existing tool (the Manchester Pizza Finder) with new functionalities and enhancements. The new tool is called the Manchester Sushi Finder; since it is build mainly for sushi ontology that was previously developed by Ontology Engineering course unit. This does not mean the tool will run only sushi ontology, but it can run ontologies with similar structure, concept domain and have specific configurations.

## Aims

The aim of this project is to investigate and demonstrate the benefits of using OWL ontologies and OWL API within ontology driven UI application as shown in the project page [6]. As well as, making the process of checking and testing ontology easier for students by uploading their ontologies, this will be shown by implementing a configurable and flexible UI. So that most of the configurations will lay in the ontology file, and the UI could browse other ontologies that contain some specific configurations as annotations. The application is called the Manchester Sushi Finder, where a user can construct queries to search for sushi based on included and excluded ingredients defined in conceptual model represented in ontology file.

## Objectives

To achieve the aim of the project, the aim is divided into several of objectives. These objectives are:

* Gather project requirements.
* Increase the reusability of the UI by making it configurable to suite content of other conceptual models.
* Increase the usability of the UI by showing the languages available in the ontology with their percentage and switch between them.
* Increase the accessibility of the system by applying filters on the content of the conceptual model or/and on the result of the search query. By introducing the notion of filters and facets search to access more specific information.
* Increase the accuracy of the system, so users can only construct valid queries and they get the intended results. Making the UI driven by ontology and using the faceted browsing along with will increase the accuracy of what needed to be queried.
* Provide more flexible system by saving most of the configurations as annotations within the ontology itself.
* Represent the constant of the conceptual model with different views such as tree, and list. Users have more one option to view the content of the model.

## Contributions of this Project

This project was undertaken to enhance and add more functionalities to an exiting tool (The Manchester Pizza Finder), which allow users to browse pizza toppings and construct queries to get certain kind of pizza. During constructing query, user chooses included and excluded toppings. As a result, pizza that matches specified criteria will be shown in the result window. This tool can run only one static pizza ontology.

The new tool (The Manchester Sushi Finder) can run ontologies with specific annotations in them as configurations. The new tool can browse the ingredients of any food domain associated with certain annotation properties. The tool has the ability to upload different ontologies during the runtime. Filters decided in the ontology file as annotation and displayed in the tool if they are exist. The tool has the ability to show facets if they were specified in the ontology to be applied on the result. Furthermore, it provides different views (tree view and list view) of the ingredient to ease the process of browsing. It would show languages if the ontology is labeled with different languages and would show also the percentage of the languages according to the ontology.

As part of ontology engineering course unit to develop food domain ontology to demonstrate for student the use and benefit of OWL, this tool would ease the process of check ontologies and might help them to understand the concept faster. Students can see their ontologies running using the tool and can see where are they going to clearly. The tool use annotations heavily, in order for the mentioned functionalities to be working. Finding some limitation in OWL annotation techniques may contribute in considering a fix in newer version of OWL in the future.

## Structure of the Dissertation

# BACKGROUND

## OWL

### OWLClasses

### OWLObjectProperties

### OWLDataProperties

### OWLAnnotationProperties

## OWL API

## Conventional Information Retrievial Mehtod

## Ontology Based User Interface

## Faceted Based Search

## Ontology Visual Querying

## The Manchester Pizza Finder