Designing an ontology for managing diets for Chronic Diabetes Disease

Pelokazi Malimba
University of the Western Cape,
Robert Sobukwe Road, Bellville,
Cape Town
3565074@myuwc.ac.za

ABSTRACT

The construction of an ontology that could serve as a recommendation system for diabetics is described in this paper. Many persons with diabetes are unaware that they have diabetes until it has progressed to the point where they are unable to digest certain nutrients[1]. The author has created an ontology that covers the nutrients in foods as well as the connections between nutrition, diabetes, and overall health. The aim is to develop an ontology that characterizes the domain and serves as a knowledge base to help people with diabetes, a) recognize and avoid foods that may aggravate or trigger the user's symptoms and b) Choose meals that are suited for the patient's situation. The focus will be on a food item or meal selection, as well as the risks connected with each meal, whether it is a good or bad meal with the chosen meal that may aggravate the chronic disease. Protégé, a tool for editing ontologies, will be used by the author. The paper starts with a literature survey of several ontology designs. The Ontology 101 technique was used to build the model. The findings suggest that the ontology could be used to give information to help people understand the complicated effects of nutrition on health and outcomes[2]. The ontology can be used to provide support to patients who are trying to treat chronic Diatec disease, according to the researchers. The research is important for those who develop knowledge organization systems and ontologies in the healthcare industry.

KEYWORDS

Chronic Diabetes Disease, food and nutrition, Ontology, Knowledge-Based System

1 INTRODUCTION

Nowadays prevention of diabetes is a major problem because of lifestyle, tension, work environment, food habits which are major causes of diabetes[2]. When a person's blood glucose levels are higher than usual but not high enough to be diagnosed with diabetes, they are said to have prediabetes. If the patient does not follow the recommended diet and activity, this stage may progress to diabetes. The diet ontology for diabetes includes terminology for various types of diabetes, such as type 1, type 2, prediabetes, gestational diabetes, and so on. It's a complicated condition with a wide range of symptoms. Weight loss that isn't explained, excessive hunger (polyphagia), thirst (polydipsia), frequent urine (polyuria), dehydration, leg pain when walking (claudication), exhaustion, disorientation, and itching are some of the symptoms (pruritus)[3]. People who are aware of these indications and symptoms are more likely to be attentive to the start of diabetes. Ontology can be used to intelligently process the information above[3]. The food to eat and how to eat it are both explicitly specified in the diet ontology.

It's always a good idea to double-check with your doctor to ensure that your blood sugar levels are still within normal limits. If you've been diagnosed with diabetes, eating a well-balanced diet is crucial for slowing the disease's progression[4]. A dietician or doctor must be consulted for a patient's diet to be correct. Doctor's and dietician's consultations are not inexpensive, patients may be able to avoid the costs associated with obtaining advice from medical professionals if they have a tool to consult about their dietary needs. The problem for these patients will be handled by creating an ontology tool that will help them choose the right meal. The author will take the essential words used by dieticians and utilize them to create an ontology that will help diabetic patients understand the low, medium, and high risks of eating a certain meal.

Furthermore, this information would have a stronger influence on their decision-making. Ontology operates as a repository for domain concepts and gives a structured representation of domain information. The ontology will incorporate information used by professional dieticians in South Africa, to provide guiding information that is accessible to anyone. Based on the user's inquiry about what they want to consume, the ontology will notify them. The keywords (concepts) defined in the ontology must be included in the patient's query[6]. The ontology will then assess whether a meal is a good meal or BadMeal based on the rules[7]. The ontology's strength is that it is readable and intelligible by both machines and humans.

The remainder of the paper is divided into the following sections. Section 2 discusses the Literature review. The related work is discussed in detail in Section 3 in terms of modeling. Section 4: Methodology and examines the ontology's development from the perspectives of domain specialists and non-experts. Section 5 comes to a close, followed by future scope.

2 LITERATURE REVIEW

2.1 Chronic diabetic disease

Diabetes is a condition that affects the body's ability to utilize food for energy. It's a common hormonal issue that, if left untreated, can lead to diabetic consequences like diabetic neuropathy, kidney difficulties, heart problems, retinopathy, and other problems[3]. It is an illness in which your blood glucose level, commonly known as blood sugar, is abnormally high. Your main source of energy is blood glucose, which comes from the food you eat[7]. Insulin, a hormone produced by the pancreas, promotes glucose absorption into cells for use as energy. It's possible that your body doesn't generate enough or any insulin, or that it doesn't utilize it properly. As a result, glucose stays in your bloodstream rather than reaching your cells. Having too much glucose in your blood can cause health problems in the long run. Although there is no cure for diabetes, you can manage it and maintain your health. In 2015, 30.3 million people in the United States were diagnosed with diabetes, accounting for 9.4% of the population[4]. Moreover, a quarter of them was completely uninformed that they had the disease. Diabetes affects one out of every four persons over the age of 65. In adults, type 2 diabetes affects 90-95 percent of the population[2]. Diabetes is also referred to as "a touch of sugar" or "borderline diabetes." These words imply that someone does not have diabetes or has a milder form of the disease, however, diabetes affects everyone. Because excessive blood glucose causes issues including heart disease, stroke, renal disease, vision problems, tooth problems, nerve damage, and foot problems over time. Increased thirst and urination, increased hunger, weariness, blurred vision, numbness or tingling in the feet or hands, unhealed wounds, and unexplained weight loss are all symptoms of diabetes[3].

Table 1: Different types of diabetes[9]

Types of diabetes	Description of diabetes
Type 1 diabetes	Type 1 diabetes is more frequent in children and young adults, but it can affect anyone at any age. If you have type 1 diabetes, your body does not generate insulin. The insulin-producing cells in your pancreas are targeted by your immune system, which destroys them. People with type 1 diabetes must take insulin every day to stay alive.
Type 2 diabetes	On the other hand, this kind of diabetes is more common among middle-aged and older people. The most common type of diabetes is type 2. If you have type 2 diabetes, your body does not produce or use insulin properly. Type 2 diabetes can attack anyone at any age, including children and teenagers.
Gestational diabetes	However, if you've had gestational diabetes, you're more likely to get type 2 diabetes later. Some women develop gestational diabetes while pregnant. Once the baby is born, this kind of diabetes normally goes away. Type 2 diabetes may get diagnosed during pregnancy.

A lot of factors, including your genes and lifestyle, increase your chance of developing type 2 diabetes. Although risk factors like family history, age, and ethnicity cannot be changed, lifestyle risk factors like food, physical activity, and weight may[9]. These lifestyle changes could reduce your risk of developing type 2 diabetes. The diet, on the other hand, will be the focus of this paper.

2.2 Diabetes Diet

The food we eat can affect our risk of developing chronic illnesses like diabetes. What we put into our bodies has a big impact on our health and can increase our risk of developing a variety of diseases, including diabetes and kidney disease[8]. Some patients are encouraged to undergo Medical Nutrition Therapy (MNT), which is a method of treating chronic diseases that involves following a diet tailored to the patient's individual nutrition/metabolic state and being followed by a licensed dietitian or professional nutritionist[3]. Nutritionists are frequently entrusted with informing patients about various foods and their qualities, and they frequently prescribe substitutions or the entire elimination of certain foods or ingredients from the diet. A person's age, gender, and general health state, in addition to the nutrition profile of foods, can influence their suitability for them. Nutritional research can help us understand how and why certain foods influence us the way they do[9][10]. To control your blood glucose, you must balance what you eat and drink, as well as any diabetes medications you may be taking. What you eat, how much you eat, and when you eat are all essential factors in maintaining a healthy blood glucose level. Maintaining a healthy weight, reducing total fat (particularly saturated fat), eating enough protein, and avoiding carbohydrates with added sugars or refined grains are all examples of following a diet plan. Alcohol can cause your blood glucose level to drop too low if you use insulin or diabetic treatments that enhance the amount of insulin your body produces.

You must maintain track of your nutritional consumption, which includes protein, carbohydrates, and fats.
2.2.1 Protein: Protein is required for the body to grow, mend, and maintain health. It is also a component of your body.
2.2.2 Carbohydrates: They also give your body energy; fruits and vegetables are good sources of carbs. Because carbohydrates (refined carbs) transform into glucose in your body and affect your blood glucose level more than other foods, you should restrict your consumption of carbohydrates (carbs). Counting carbs might help you keep track of your blood sugar levels[7].
2.2.3 Fat: They are also an energy source. Heart disease and weight growth can both be caused by excess fat. Limit your fat consumption and choose "healthy" fat (unsaturated fat) to help lower cholesterol[3].

2.4 Importance of Semantic Technologies

The increasing diversity of data and techniques to accomplish complicated tasks needs skilled management and automated reasoning[12]. It is critical to have semantic interoperability (the ability of a technology system or software to interact, share, and use data). The use of semantic technologies allows each system to stay independent while using a description of the topic of interest and the logical context of the information to exchange[13].
When you wish to add new knowledge to semantic technology. You simply enter the data, and the reasoner will automatically choose how to use it. The Semantic Web is a view of the future of the Internet in which data is given explicit definition, making it simpler for machines to automatically analyze and integrate data available on the Internet. The purpose of semantic technology is to discover the meaning of data[17]. Semantic Web technologies offer algorithms and solutions for deciphering data's meaning.

2.5 Ontology and OWL Language

Ontology is the study of what is, of the different types and structures of things, qualities, events, processes, and relationships that exist in all areas of reality The ontology provides a uniform conceptual definition of domain knowledge, allowing knowledge to be shared, reused, and redundant descriptions to be reduced. Ontology is made up of classes, attributes, and relationships between classes and individuals in most cases[8][17]. They define significant domain ideas (object classes) and their attributes. The Web Ontology Language (OWL) is a programming language that is used by applications that need to process the content of data rather than just display it[15]. OWL is better suited for conveying semantic information than prior languages such as XML because it can describe machine interpretable content on the web through an explicit representation of concepts in a vocabulary and relationships between those terms[16]. OWL provides for the description of classes and properties, including disjoint relations, cardinality, equality, better property typing capabilities, enumerated classes, and property characteristics. [18] Ontologies can be used for a variety of purposes, including providing a restricted vocabulary, customizing, and personalizing search options, extracting document content, word meaning, and semantic annotation of textual texts, among others. Ontologies can explain both tangible and abstract objects, which are grouped into classes and characterized by a set of attributes. An object's attributes are its qualities and characteristics[17].

2.3 What is Protégé?

Protégé is an ontology editor that is free and open source. Users can develop ontologies in both frame and web ontology language (OWL) frameworks. Protégé allows users to import, edit, and save existing ontologies written in OWL, as well as create new ones[18]. It can save ontologies in a variety of formats, including XML, OWL, and it can visualize ontologies in graphical form, as well as populate them with concrete instances of classes[17]. Protégé is intended for people working in the fields of ontology and knowledge modeling, as an understanding of the underlying axioms is almost always necessary.

3 RELATED WORKS

Many existing systems have been established to classify foods based on their nutrients to offer patients a diet plan. Ontologies are utilized to construct intelligence systems in practically every domain. They make it simple to look for and share information. The following is a summary of the research ontology related to the incorporation of food and nutrition in the study[11].Design and creation of a recommended food menu for restaurants, clinics, hospitals, and private residences. The principles of expert systems were merged with ontology food and nutrition in this study to aid in the selection of meal menus for patients based on their medical conditions as well as their food preferences. The system uses food ontology to assist the user in finding a meal to eat. Ingredients, availability, nutrients, utensils, preparation methods, regional cuisine, dishes, maybe nutrition, and price were used to determine the food classes. [9]From a nutrition support health care of diabetic patients, I created a food ontology for diabetes control. The ontology was created using certain diabetes-related nutrition recommendations as a starting point. Beverages, egg products, fruits, grain products, meat, milk products, and other food kinds were defined as part of the food ontology. The number of nutrients, such as protein, carbohydrate, fat, vitamin, mineral, fibre, and so on, was one of the defined qualities[15]. Was created to provide nutrition and eating recommendations that were tailored to the individual. A knowledge-based framework was used to create the food ontology and recommender system. The system's core components are a human profile, a food and nutrition ontology, and a rule-base for making meal suggestions. According to the studies cited above, no system delivers risk recommendations based on a specific menu, because too much of anything is bad[20]. They are also concerned with the number of calories a patient should consume. This is excellent, but it can be challenging and unpleasant for a patient who isn't well-informed and simply needs to know whether eating 5 chocolates or 2 bananas per day puts him or her at high, medium, or low risk[19].

This study led to the development of a design idea ontology food and nutrition advice on food to appropriate physical condition and food from to largely adjust to the older individuals who are mostly battling with chronic disease. It also features a nutrition plan for each meal, day, and week to properly and efficiently control the physical condition and food.

Personalized Information Platform for Health and Life Services (PIPS) was designed and developed by Cantais et al. to provide nutritional descriptions for various types of food [10]. PIPS focused on ready-made meals; the user had to add the components, and the ontology would determine whether or not the meal was compatible. Following ontology building steps similar to those used in the creation of PIPS. The author will take the following steps to build an ontology:

4 METHODOLOGY

Ontology design is a creative process in which the designer examines the ontology in various structures, concepts, and relationships. The construction of an ontology goes via several stages and techniques. There is no one-size-fits-all method for producing the same. The new method is to efficiently discuss the production of domain ontologies using a common software development paradigm. For the first iteration of the ontology, we used the distinct phases of the waterfall model [12] to develop it. Because ontologies may be reused, a fast-prototyping strategy is used for the refinement of successive versions. The ontology development life cycle for the establishment of symptoms ontology is depicted in Figure –1.

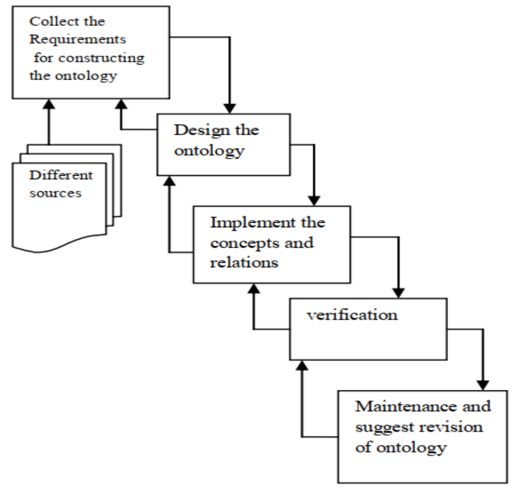

Figure 1: Waterfall model for ontology construction

The waterfall model [12] is used to construct ontologies, which necessitates following the steps outlined below. Each phase serves a distinct purpose, which is detailed below:

Determine the ontology's domain and requirements. Acquire knowledge of the diabetic domain to examine the relevant criteria and determine the domain's scope for ontology creation. The aim of the ontology is clearly defined during this phase, as are the challenges that your ontology should solve. The study's topic is nutrition, to develop an ontology that can assist a patient with a diet plan. The construction, evaluation, and re-use of ontology all benefit from a well-defined requirements definition. Diet knowledge for ontology was obtained from textbooks, research articles, a professional nurse from the Eastern Cape's Department of Health, patients, and other encyclopedias. The types of queries that can be asked must include at least one food item; otherwise, the answer will be all meals that contain all or part of the food items.

Design the ontology and find and use a pre-existing ontology. Identify the diabetes domain's major concepts, their attributes, and the relationships that exist between them; Structure your information into concepts that are arranged logically. Food control, for example, is an explicit notion in the diabetes domain. Using an object-oriented approach, the ontology is appropriately created in the form of attributes and their relationships. The following sub-steps must be followed when designing ontology:

- Enumerate important terms related to ontology
- Using the terms that have been determined, define the classes and the hierarchy of classes.
- Define the concepts slots and properties of classes.
- Define each facet's characteristics.

It is advantageous to use an existing ontology as a guide during the creation process[1]. Developed an ontology that is best appropriate for diabetes meal suggestions. This study will make use of some of their work.

Define classes, class hierarchy, and properties of classes. Information regarding food and nutrition has been gathered from food and nutrition experts, books, and other sources of reference to knowledge that may be used to recommend a menu in the Knowledge Base. It consists of the following components:

• Nutrition and Food Ontology is a part of food and nutrition information that is used to create an ontology categories and relationships.

• Rule-Base as part of expert knowledge to build rules or criteria to acquire a patient-appropriate menu of foods.

Choose your instances. Food products, such as sweetcorn, broccoli, pasta, and so on, will be the instances at this point.

5 MODELLING

Ontologies have gained widespread acceptance and application in cutting-edge information and intelligence collecting, retrieval, knowledge representation, and database management systems [8]. Modeling is a key step in the construction of an ontology. Because there are numerous conceptual parallels between the creation of an ontology and the design of a database. As a result, in ontology creation, structuring object classes in a class hierarchy and establishing links between classes is critical. Food details, such as animal-based or plant-based food, are combined with nutritional information, such as vitamins, proteins, fats, carbs, and so on, to form the ontology. This information can be utilized to provide dietary and nutrition recommendations that are appropriate for the individual's physical state. When modeling, it's crucial to keep in mind the types of queries that will be addressed in the ontology. The author will be able to know whether a food item is a badmeal or GoodMeal because of the amount of sugar, fats, and refined carbohydrates the food item has. The author will also create a few well-balanced menus. Queries can take the following forms:

- Query about milk with low, medium, or high calorie and carbohydrate content.
- Select a meal containing one or more food items, such as avocado for lunch, broccoli, and carrots for a second meal, or egg and bacon for breakfast. The result will be a list of all menus that satisfy the query.
- Query about low- and high-risk meat and meat substitutes.
- Query whether a fruit or vegetable has a low, moderate, or high risk of diabetes. For instance, one banana is low risk, but three or more bananas per day are high risk for a diabetic.
- Query starches with low to moderate or high energy and/or fat content.
- Submit a query for a sugar, fat, or beverage exchange.

4.1 Development of foods ontology

The planning procedure for the recommended food menu is discussed in this section. This is the first step in the research, in which we add dietary information to the ontology, which consists of concepts, relations, characteristics, and individuals. All of the material for this section was gathered from food references as well as nutrition specialists. Table 2 depicts the food ontology's hierarchical structure. Each food on the menu will have a hasIngredient property, implying that an isIngredientOf property will be required. Object properties are a form of property that connects two individuals (or instances) and adds restrictions to classes. There is also a datatype attribute that connects an individual to an object, such as a text, integer, date, or Boolean. The datatype attribute will be utilized in this study to relate food items (individual) to a general string because the focus is not on the number of calories in the meal but on whether it poses a low, medium, or high danger to a patient if they consume it. Annotation properties are another form of property that can be used to add comments to an ontology. We separated the list of meal menus based on the type of diabetes at this point. This allows the user to search for a certain menu based on their diabetes type. This is where nutritional standards are used to choose appropriate diets for patients.

Table 2: Shows how it is formatted and how the classes and subclasses are created

Main class	Sub-classes for food item breakdown
Thing → Food_item	● Dairy ● Fatty_foods ● Fruit ● Protein ● Starch ● Vegetables ● Drinks
Thing →Meals	● Tomato Pasta ● Beetroot and chicken ● Carrot Cake ● Tea and Herbal tea ice cream

Thing → Risks	○ Food_Ingredients ▪ Fats ▪ Refined_Carbs ▪ Sugar ○ GoodMeals ○ BadMeals ▪ LowRiskMeal ▪ MediumRiskMeal ▪ HighRiskMeal

4.2 Development of rules

This is where nutritional standards are used to choose appropriate diets for patients. Some of the rules are as follows: Food and nutrition specialists and publications about food and nutrition for patients have provided rule-based information for advising food menus appropriate to the physical condition of patients. The food and nutrition ontology is used in the rule-based system. The ontology's rules act as an inference engine. The rules will be written in the Protégé editor using the Semantic Web Rule Language (SWRL)[17]. Boolean connectives, quantifiers, objects, and predicates are used to write the rules.

- Objects: In this example, the object is a concept or a person.
- Quantifier: an expression that specifies the range of application of a symbol or word.
  All: ∀
  Some (Existential): ∃
- A boolean connective is a word or symbol that is used to grammatically connect two or more sentences. The following are some examples of quantifiers:
  Examples of quantifiers are listed below:

Not (negation): ¬ And (intersection): ∩
Or (union): ∪
Only if: →

- Predicate: something that is affirmed or denied in respect to a proposition's argument, such as categories or relationships.

Table 3: Examples of SWRL rules are as follows

Property restrictions	SWRL rules
Constraint	• **Constraint: Every drink that has soda/acid is a BadMeal.** ∀x(drink(x) ∩ contain(acid)) → BadMeal(x).
Constraint	• **Constraint: Every dry fruit is a good meal.** ∀x(dry-fruit(x)∩ contain(orange)) → GoodMeal(x).
Constraint	• **Constraint: Some foods are not BadMeals.** ∃x(foods(x) ∩ (¬contain(whole-wheat))) → BadMeal(x).

The ontology is part of a bigger system that will be analyzed to determine the characteristics of a diabetic instance. When a diabetes dataset is entered into the reasoner, the reasoner will check the rules to see if the dataset has one of the attributes badmeal or goodmeal. The reasoner uses the rules to make inferences, hence they are the most important part of the ontology construction. We will be able to divide diverse meals into appropriate menus using the rules. Some meals, for example, will include both fruit and a snack. Some guidelines will be established and used for the selection of these fruits that also serve as snacks. The menu class structure is depicted in the diagram below.

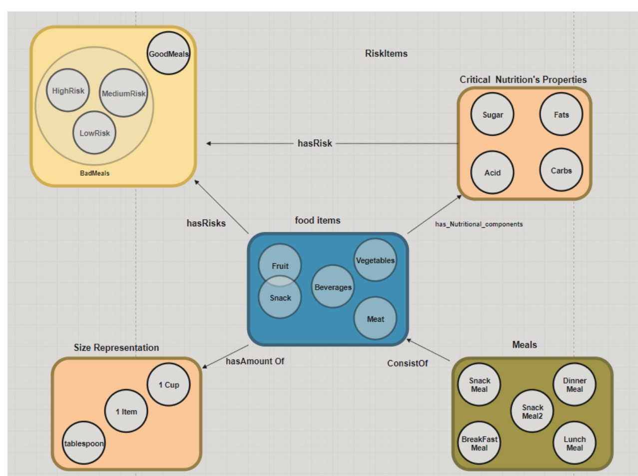

Figure 2: Diabetic breakdown model implementation

The following are some of the features that will be included in the ontology.

BadMeal features

- If a drink has acid, it is a BadMeal.
- If a meal has more than 1 cup it is a BadMeal.
- If a meal has added sugar, it is a BadMeal.

GoodMeal features

- If a meal has no added sugar, it is a GoodMeal.
- If a meal has no refined carbs is a GoodMeal.
- If the drink is water, it is a GoodMeal.

Rules to assess the features are checking the following:

- Check sugar
- Check fats
- Refined carbs
- Check AmountOf
- Check AmountOfCups
- Check piecesOf

Sugar
If sugar (>)36 grams = High-Risk Meal
If sugar (=) 36 grams = Low-Risk Meal
If sugar (<) 36 grams = Good Meal
Carbs
If Refined Carbs (>) 75 grams = High Risk Meal
If Refined Carbs (=) 75 grams = Low Risk Meal
If Refined Carbs (<) 75 grams = Good Meal
Fats
If fat (>) 15 grams = High Risk Meal
If fat (=) 15 grams = Low Risk Meal
If fat (<) 15 grams = Good Meal

The numerical values are used to determine whether a meal is a good meal or a bad meal. For example, if a meal contains sugar greater than 36 grams and refined carbs greater than 75 grams, and fats greater than 15 grams. That meal will be a BadMeal and a HighRiskMeal for a patient with diabetes and therefore they are advised not to eat that meal.

6 IMPLEMENTATION

The project was implemented with the help of the "protégé editor" ontology editor. The ontology is built using Protégé 5.5.0 and Ontology Web Language (OWL)[17] The author spent time during requirement collecting looking over the practical instructions on how to develop an ontology in protégé. The manual covered not only how to use the editor, but also set theory basics. One of the prerequisites for developing an ontology is set theory. The project uses OWL DL because, first and foremost, it allows for the expression of many cardinalities, while the other languages are unsatisfactory or more complicated. The author will first build classes and subclasses, then properties and individuals, to develop an ontology.
The diabetic ontology model consists of:

Main class

- Owl thing

Classes

- Risks
    - Food_Ingredients
        - Fats
        - Sugar
        - Refined carbohydrates
    - GoodMeal
    - BadMeal
        - LowRiskMeal
        - MediumRiskMeal
        - HighRiskMeal
- Food_items
    - Dairy
    - Fatty_foods
    - Fruit
    - Protein
    - Starch
    - Vegetables
    - Drinks
- Meals
    - Tomato Pasta
    - Beetroot and chicken
    - Carrot cake
    - Tea and herbal tea ice cream

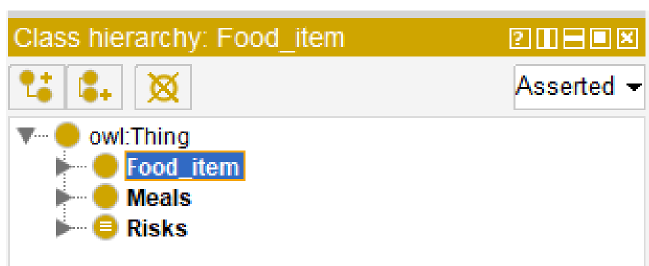

Figure 3: Partial class hierarchy.

Object properties and Data properties

- hasIngredient
- hasAmount
- hasSugar
- hasFats
- hasRefinedCarbs
- hasNutrionalComponents
- hasRisks
- ConsistsOf
- has Acid
- hasPiecesOf
- hasAmountOfCups
- hasAmountOf

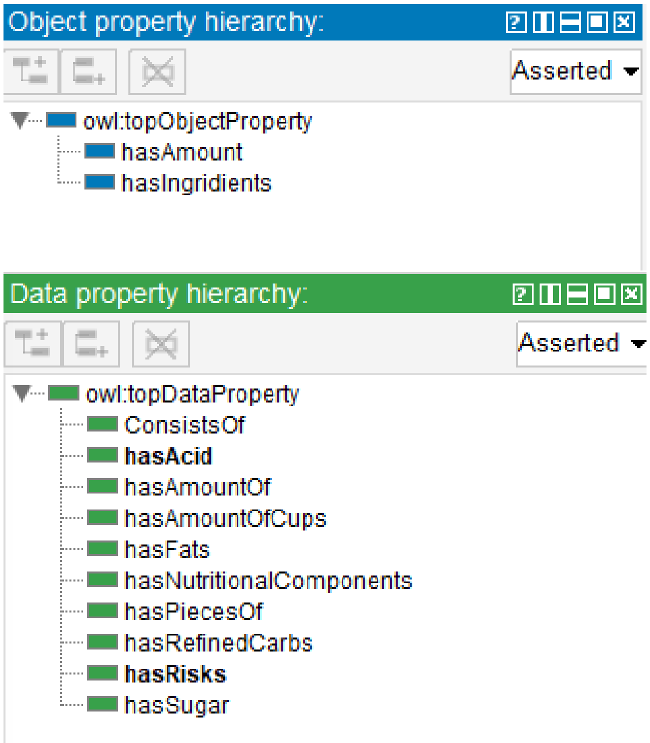

Figure 4: Partial Classes, Properties, and Individuals of the Knowledge base.

Figure 5: Class description of Meal

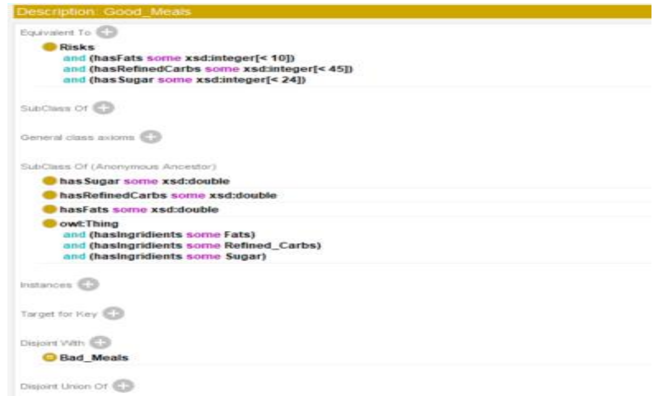

Figure 6: Defined classes for meals and GoodMeals

Several new features were added to the ontology, including the classification of meals as GoodMeal or BadMeal, as well as the classification of food products based on their sugar, fat, and refined carb content. The asserted class hierarchy tab shows before the reasoner runs, and after the reasoner runs, we can switch from asserted to inferred class hierarchy to see the results. The results of what has been developed are shown in the inferred class hierarchy. The reasoner determines whether a meal is a GoodMeal or a BadMeal, and then further categorizes them based on the patient's risk. The risk class, for example, has subclasses such as low risk meal, medium risk meal, and high risk meal. In this situation, the reasoner selects which category the meal belongs to based on the guidelines established by the author. The asserted and inferred class hierarchy had to be altered as well; the modifications are depicted in figures 7 and 8 below.

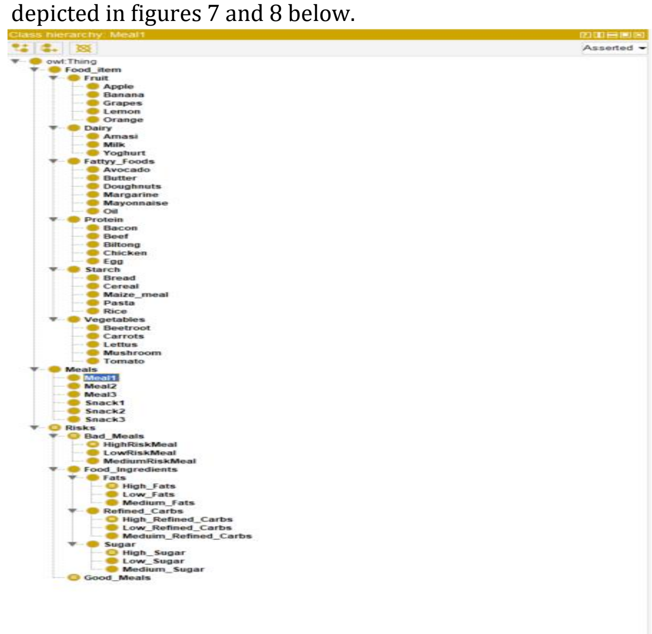

Figure 7: Food_item Asserted class hierarchy.

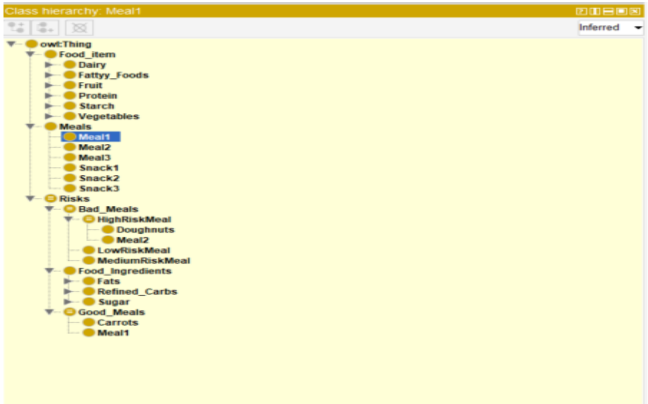

Figure 8: Food_item Inferred class hierarchy.

Below are the results of GoodMeal and BadMeal generated by the DL query

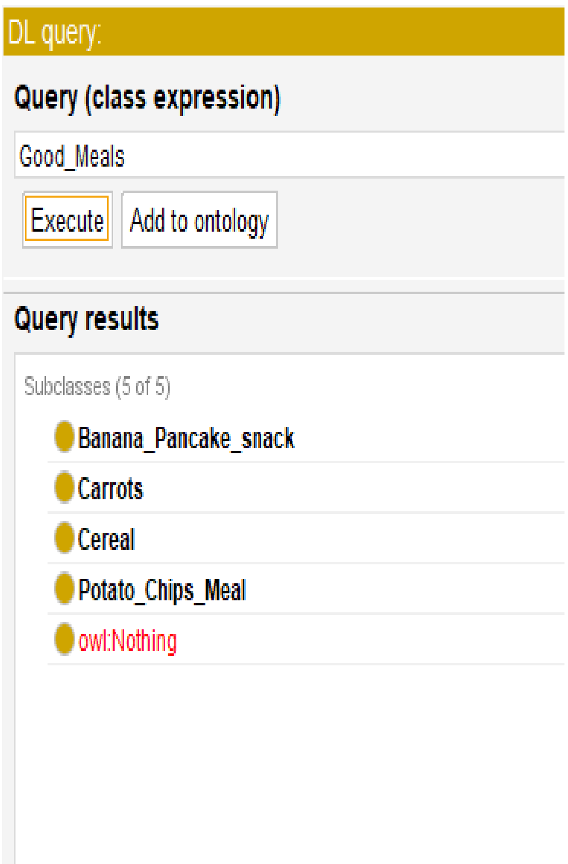

Figure 9: DL queries for GoodMeal

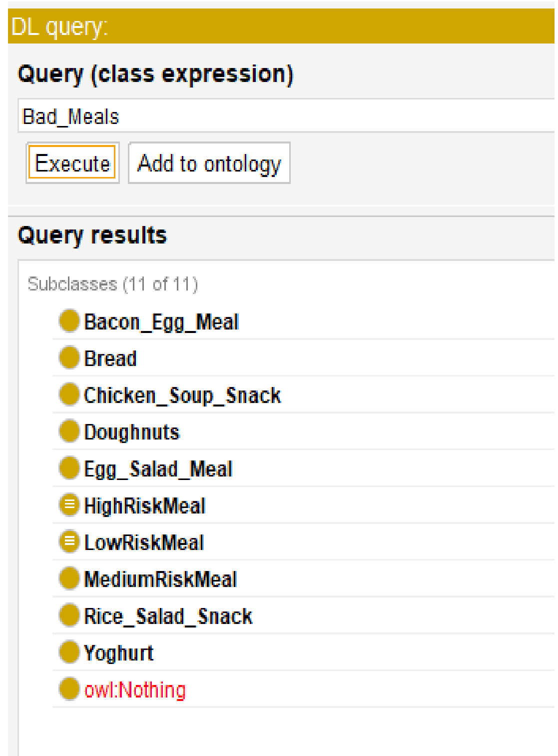

Figure 10: DL queries for BadMeal

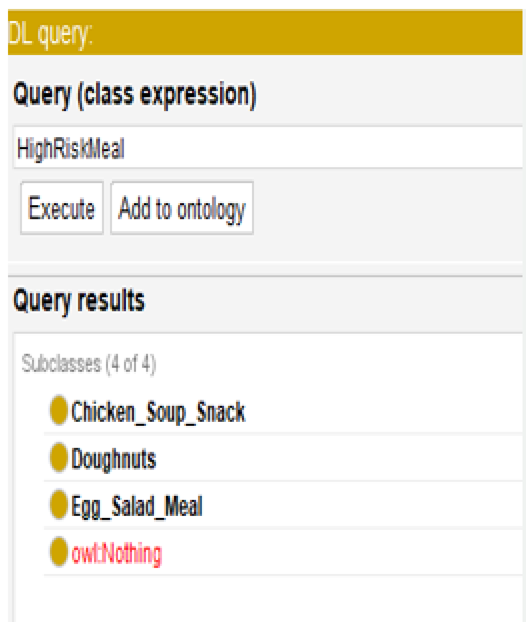

Figure 11: DL queries for HighRiskMeal

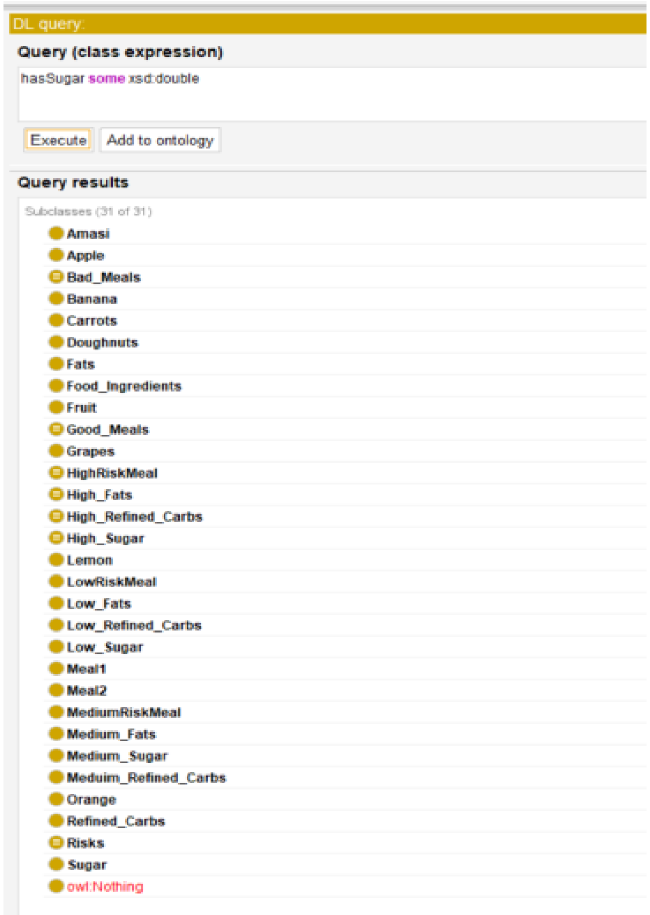

Figure 12: DL queries for meals that have sugar

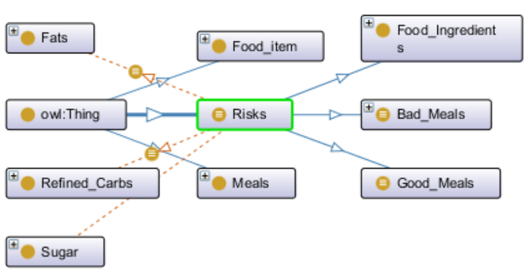

Figure 4: Partial tree of the knowledge base.

7 CONCLUSIONS

An Ontology-Driven Personalized Food and Nutrition System for Patients with Diabetic Chronic Disease was demonstrated in this article. The goal is to help hospital staff or clients plan proper diet and nutrition by providing advice and meal planning for meals that are acceptable for their physical condition. The system makes use of a food-oriented ontology as well as an expert system that can access the ontology's structure as well as a knowledge base on foods and disorders. Ontologies are a versatile and effective way of storing information about domain concepts and their relationships [7]. The ontology will not only help with diet, but it will also save time and eliminate errors made by dietitians and doctors. The criteria will be utilized to categorize the data automatically in this study. The data is divided into categories based on the food content. You don't need a background in computer science to create an ontology. The ontology may also be used to make food item suggestions while shopping, for example, you can search for fruits and vegetables that are safe for a patient to eat. Subclasses have been added to the ontology. We only ran into issues with protégé since the ontology is primarily used for inferencing by large computers. More knowledge on physical exercise and other activities, which are part of a healthy lifestyle, is needed to fulfill the goals of recommending a healthier lifestyle. The automation of hospital food supply purchasing and inventory is another issue that has not been investigated in this study. Solving this issue would improve the situation even more, particularly in hospital administration.

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