This is a report on ontology based on the field of diseases and medicines which would be helpful for patients and doctors.

Report on Ontology

An ontology prepared for medical science

**Part 1 ONTOLOGY**

**1.1 Introduction identification and need of ontology-based solution to the problem**

This report is prepared based on ontology approach to the field of medical where the program would give the name of diseases, its symptoms, its causes, medicines to be used for diseases and the possible side effects of medicines along with types of medicines and diseases.

According to the Cambridge Dictionary, ontology is “the part of philosophy that studies what it means to exist.” (Walter, 2012) Similarly in AI, ontology is an identification of meanings of acronyms used in the system. It describes the individuals, attributes, and the relationship between them. (Poole & Mackworth, 2010) According to above mentioned definitions, ontology gives a clear view to the concept of some information or ideas.

Ontology based system gives platforms based on contents and relationships which mimics human performance. It helps to reach the targeted goals without any economic or time investment on the training regarding the terminologies used for system. Thus, ontology is required to enhance accuracy of algorithm by providing dynamic perception on the relations between individuals, attributes, and classes. (Earley, n.d.)

In this report, ontology is used to visualise the relationship between diseases, its causes, its symptoms, medicines used for diseases and the possible side effects caused due to medicines. “Disease” is the abnormal condition that disrupts the normal functionality of mental or physical situation of an organism. (Anon., 2012) “Medicine” is a compound or chemical that cure or prevents disease, ease the symptoms of diseases or help in testing the disease. (Hilmus, 2018)

This ontology provides logical consistency between the medicines and diseases using description logics which would be useful for both doctors and patients. It helps to analyse the conditions of patients and the medicines being used. Along with the development on the technological field, the confusion among common people regarding the correct information on internet is also increased. So, there is high need of precise and correct information without any confusion regarding their health for common people to live their life in a healthy way and to deal with the increasing health problems that they must face due to various causes. The prepared ontology would be very useful on this case. With formalization of the ontology-based information regarding various diseases and medicines, people would get vivid knowledge about the condition they are going through and the medicines that they are taking.

* 1. **Relating works**

Deep thinking and concentration along with skills to develop the solution is required while developing the ontology. There are numerous ways to develop the ontology. This ontology was developed by using the entity relation diagram which is presented in the figure below:

Chart

Description automatically generated

Fig 1.1 : Basic presentation of entity relation diagram

According to the Fig 1.1, Diseases requires uses of medicine and medicine is required for diseases.

A screenshot of a computer

Description automatically generated with low confidence

Fig 1.2: Relationship between Disease and Medicine

Disease have five sub-classes. They are: disease name, symptoms, causes, test and disease types.

Diagram

Description automatically generated

Fig 1.3: Sub-classes of disease and relation between them

Disease name is caused due to causes and causes cause disease name. Types or classes of disease is subclass of disease name. Symptoms is seen on diseases and disease have symptoms. Test is used to test disease name and disease name is tested using test. Disease type is type of disease name.

Medicine have three sub classes. They are: Medicine name, side effects and medicine types.

Diagram

Description automatically generated

Fig 1.4: Subclasses of medicine and relation between them.

Medicine name has side effect. Types of medicine is type of medicine name.

There are individuals of all the classes or sub-classes which is illustrated in the given picture.

Diagram, schematic

Description automatically generated

Fig 1.5: Full representation of Entity relation diagram

The diagram started by defining the classes and subclasses. After which, domain and ranges were decided along with object property and data properties. The individuals of diseases name were assumed on the basis of common diseases seen around and further research was done for other individuals of other subclasses using the website of NHS to gather the precise information.

* 1. **Construction of ontology**

After preparing the entity diagram, designation and identification of four main elements of ontology was required which are classes, individuals, properties and relation between them. After defining all this, Protégé version 5.6.1 was used to make this project of ontology. The ontology revolves around chosen diseases and medicine used for them along with inherited characters. The ontology contains 11 classes, 26 object properties, 9 data properties, 91 individuals and 749 axioms.

Graphical user interface, application

Description automatically generated

Fig 1.6: Ontology Metrics

* + 1. **Presenting classes through ERD**

Diagram

Description automatically generated

Fig 1.7: OWL Viz of the ontology

All classes are represented according to the entity relation diagram shown on fig 1.1. There are three main classes and respective sub-classes; is-a is relation between the classes and sub-classes represented on diagram. Every class has properties which makes easier to understand the functions of classes and restriction is created as “equivalent to” to make the relation vivid.

Graphical user interface, text, application, chat or text message

Description automatically generated

Fig 1.8: Annotations and equivalency

* + 1. **Creating object properties**

Object properties were created to join two individuals using predicate.

Graphical user interface, application

Description automatically generated

Fig 1.9: object properties

Here, Causes is domain which is joined with the range disease name using the predicate causes. The inverse function is used to denote that it is exactly opposite of object property is caused where Disease name is domain and causes is the range. The same was done with all other object properties.

Graphical user interface, text, application

Description automatically generated

Fig 1.10: domain and ranges

* + 1. **Creating data properties**

Data properties have own datatypes which includes string, integer, Boolean, datetime and others. All the data properties were created on the basis of ER diagram to which the domain is different entities and range is builtin data types.

Graphical user interface, text, application

Description automatically generated

Fig 1.11: data properties

* + 1. **Individuals**

As mentioned before, there are 91 individuals and all of them are presented below:

A picture containing text

Description automatically generatedText

Description automatically generatedA picture containing text

Description automatically generatedA picture containing text

Description automatically generated

Graphical user interface, text

Description automatically generated

All the individuals have their object properties and data properties. Let’s have a look over the individual Asthma;

Graphical user interface, application

Description automatically generated

Asthma has object property requires uses and its range is steroid which means asthma requires uses of medicine steroid. It is same for all the object property used in property assertions of asthma.

* + 1. **Reasoner**

After the development of ontology along with its functionality and compatibility, reasoner was used to verify the project. Hermit 1.4.3.456 verified the ontology. There was no problem while verifying the compatibility of ontology.

Graphical user interface, text, application

Description automatically generated

* + 1. **OntoGraf**

This is the OntoGraf with all the classes and sub classes. It supports the interactional navigation of OWL ontology.

Chart, diagram, radar chart

Description automatically generated

# References

AI World School, n.d. *AI for Clean Air: This technology is absolutely effective!.* [Online]   
Available at: https://aiworldschool.com/research/ai-for-clean-air-this-technology-is-absolutely-effective/  
[Accessed 9 April 2022].

Anon., 2012. *infectious disease news.* [Online]   
Available at: https://www.healio.com/news/infectious-disease/20120625/what-are-diseases  
[Accessed 23 March 2023].

Beall, A., 2018. *It's time to address artificial intelligence's ethical problems.* [Online]   
Available at: https://www.wired.co.uk/article/artificial-intelligence-ethical-framework  
[Accessed 10 April 2022].

Blackman, R. & Ammanath, B., 2022. *Building Transparency into AI Projects.* [Online]   
Available at: https://hbr.org/2022/06/building-transparency-into-ai-projects  
[Accessed 25 March 2023].

Earley, S., n.d. *The role of ontology and information architecture in AI.* [Online]   
Available at: https://www.earley.com/insights/role-ontology-and-information-architecture-ai#:~:text=Ontology%2Dbased%20AI%20allows%20the,in%20order%20to%20become%20functional.  
[Accessed 23 March 2023].

Easen, N., 2018. *The ethics of AI: how to hold machines accountable.* [Online]   
Available at: https://www.raconteur.net/technology/artificial-intelligence/the-ethics-of-ai-how-to-hold-machines-accountable/  
[Accessed 8 April 2022].

figure eight federal, 2021. *Overcome and Prevent Bias in AI.* [Online]   
Available at: https://f8federal.com/overcome-and-prevent-ai-bias/  
[Accessed 25 March 2023].

GSMA, 2022. *AI for Impact: Using the power of data to respond to climate change.* [Online]   
Available at: https://www.gsma.com/betterfuture/resources/ai4i-climate-overview  
[Accessed 9 April 2022].

Hilmus, E., 2018. *Understanding Medicines and What They Do.* [Online]   
Available at: https://kidshealth.org/en/teens/meds.html  
[Accessed 23 March 2023].

Hölzle, U., 2018. *Meeting our match: Buying 100 percent renewable energy.* [Online]   
Available at: https://blog.google/outreach-initiatives/environment/meeting-our-match-buying-100-percent-renewable-energy/  
[Accessed 9 April 2022].

Kerlin, K., n.d. *Driverless cars could be the solution to climate change- but two major things have to happen.* [Online]   
Available at: https://www.washingtonpost.com/sf/brand-connect/ucdavis/driverless-cars-could-be-a-solution-to-climate-change/#:~:text  
[Accessed 9 April 2022].

Neslen, A., 2021. *Here's how AI can help fight climate change.* [Online]   
Available at: https://www.weforum.org/agenda/2021/08/how-ai-can-fight-climate-change/  
[Accessed 9 April 2022].

Poole, D. & Mackworth, A., 2010. *ARTIFICIAL INTELLIGENCE FOUNDATION OF COMPUTATION AGENTS.* 1st ed. Vancouver, Canada: Cambridge University Press.

Walter, E., 2012. *ontology,* s.l.: Cambridge University Press.