Ontology Web Langua Ge Framework for Cognitive Design Thinking

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Abstract

Iterative, non-linear design thinking involves understanding users, challenging assumptions, redefining problems, and creating new solutions to prototype and test. As well as the set of cognitive, strategic and practical processes used by designers, design thinking encompasses the knowledge that has been developed about how people reason when solving design problems. It is also defined as 'designed ways of knowing, thinking, and acting, and 'design thinking. The study of design cognition and design methodologies has roots in the study of design thinking. Being-related branch of metaphysics describes the properties and relationships between a set of concepts and categories in a given field. In this paper, stages of Cognitive design Thinking (CDT) are defined and explained. Design thinkers solve the problem by applying the techniques in the CDT by considering all the inputs from users. Initially, the user responses are noted at the discovery phase of the design thinking. In the Ideate, Prototype stage, teams are divided, and optimal technique is applied and tested for all the inputs required by the user. Ontology web Language is used to implement the concept of CDT, resulting in generating the graphs in each phase of CDT.

Index Terms— Ontology web Language (OWL), Empathy, Ideate stage, Brainstorm, Descriptive Logics [DL], Cognitive Design Thinking [CDT]

Introduction

Designers define Design Thinking as a human-centered methodology for the creative invention that combines customer needs, technological constraints, and business success demands. Designers develop ideas through Design Thinking, which entails strategic and applied processes. Research across a wide range of design disciplines has identified interesting aspects of Design Thinking. In design thinking, users' needs are understood, assumptions are challenged, and cases are re-examined to find additional options and solutions that may not be immediately apparent.

"Design Thinking" refers to the practices, methods, and mindsets emphasized today. Consequently, advocates of Design Thinking failed to successfully consolidate and teach the knowledge acquired over the years, if not decades, of design practice to anyone other than architects. The design process has many versions today, and they usually consist of five phases or stages. [1] Ontologies are developed using description logics (DLs), a family of knowledge representation languages. The World Wide Web Consortium (W3C) has standardized OWL as the Web Ontology Language, forming the basis for its use.[2] DLs were used long before ontologies were Ontologies, like relational databases, contain structured knowledge about

specific subject areas. A practical engineering perspective shows that ontologies are much more than just text files, as relational databases and their management systems differ from text files. Intelligent information systems make use of such files. [3] Several marketing gurus describe ontology-driven information systems as "like a database on steroids!" and similar.

Data integration problems can be solved using ontologies by providing shared, agreed-upon vocabulary and constraints, which are then used so that the software can understand them.[4] It is a hierarchical data structure containing all entities, relationships, and rules (theorems, regulations) within a domain that is intended to include a complete and rigorous conceptual schema. [5][6]

Related Works

Stages of Design Thinking

Design thinking comprises of five stages: Empathy, Define, Ideate, Prototype, Test. Empathize focusses the importance of understanding the situation from the user's perspective. Essentially, the first step aims to understand the situation to understand better what needs to be done. Designers deal with a problem during the first stage of the Design Thinking process by immersing ourselves in the statements and imagining creative solutions. Depending on the particular issue, it is necessary to determine who would be helpful, the remedy, and which professionals could provide insight into current solutions.

Define refers to the analytical verbalization and definition of the documentation gathered during the empathization phase. Reflecting on the problem enables a plan to be created or a remedy to be acknowledged. During this stage, the necessity is translated into a standard benchmark. By integrating and assessing the research, knowledge we can be gained from the available information. Human-centered contexts should be used to record the research problem instead of focusing on strategic goals.

Identify the immediate needs, because the problem is obvious, and come up with solutions. During the stage of thought, a problem is identified, and a solution is discovered. A unique and productive mentality is used during the idea phase to develop inventive solutions. In this phase, the solution is created, and the process of generating actuality from the image is studied. The subconscious forms the solution during this phase of the process

A prototype is a tangible example of a solution. Authenticity, tangible, and honest are the products of this step. The purpose of prototyping is to translate ideas into tangible form so they can be presented to clients and get feedback. The design is gradually reinforced as feedback is received, starting with a simple version. Together, the client and the solution are developed

Design Thinking concludes with a test. In this stage, the prototype is reviewed, feedback is gathered, and changes can be made if necessary. During this phase, the design for the final product will be completed. The prototype is tweaked and monitored in the test stage to ensure it meets the user's requirements. It is necessary to repeat the test step until the solution is perfect and exact (Plattner et al., 2004). To achieve a satisfactory outcome, it may be necessary to return to the first phase of the process and repeat each phase. Gradually developing this framework will allow the layout to be tailored to the end user's needs. In architecture, Design Thinking plays a crucial role in creating adaptive architecture rather than beautiful designs that do not address users' needs. This concept must be incorporated into teaching pedagogies for schools of architecture to deliver sustainable, pragmatic, and inclusive designs.

As Design Thinking and related approaches have emerged in recent decades, such as human-centered and participatory design, they have highlighted the transformational role design can play in innovation. Both practitioner and academic literature have emphasized the value of Design Thinking as a strategic innovation approach. Designers conceptualize Design Thinking as an iterative, multidisciplinary, human-centered approach that leads to innovation and transformation. User needs drive the entire innovation process in Design Thinking, which means identifying and satisfying them. Design Thinking also addresses wicked problems, which calls for human-centered approaches. "Wicked problems" refer to ill-formulated social issues, ambiguous information, and conflicting values between customers and decision-makers. Taking a human perspective is the key to understanding, solving, and making sense of these problems. Empathizing with users is key to Design Thinking's human-centeredness. An empathic person accepts the perspective of others, recognizes their perspective as truth, receives inputs from various sources, suspends judgment, senses another person's emotions, and communicates by mirroring back. [7] [8]

Techniques Of the Ideate Stage

1. Brainstorming

A brainstorming session builds on the ideas of a group by leveraging their interaction to generate solutions. This technique is more effective when brainstorming with about five to seven participants. Your brainstorming session will be more focused if you have a smaller group and limit it to 20 minutes. For more diverse ideas, include participants from different backgrounds or perspectives.

The facilitator is responsible for ensuring all voices are heard and guiding the discussion during a brainstorming session. Positive feedback should be encouraged, while negative feedback should be discouraged. Ideas should be raised, listened to, and discussed by all participants.

2. Worst idea

Participants brainstorm their worst possible solutions to a problem using the worst idea technique. Despite brainstorming and encouraging all ideas, some people may still feel nervous about potential criticism, and this technique eliminates that fear by welcoming bad ideas. Participants often create ridiculous ideas and entertain one another, making it a more enjoyable environment. Having heard your team's worst ideas, your facilitator will ask you to identify the attributes that make those ideas bad. Participants must think about their opposites to turn those bad ideas into possible solutions. It is not only possible to make connections or find sources of inspiration from discussing the worst ideas, but this can also lead to positive solutions, demonstrating their incredible value.

3. Storyboarding

Processes can be designed or improved using storyboarding. Participants create a visual story presenting their ideas and possible outcomes to understand what works and what needs improvement. Your solutions should take into account the customer's journey throughout the process.

The storyboard can be compared to a comic strip, but don't worry about artistic ability. Use squares containing images or text to depict the user's journey. It would help if you determined which ideas or solutions will allow your users to feel or interact with each step within the process. Creating a storyboard for every stage in your approach can also help you realize if you missed something along the way.

4. Mind mapping

In mind mapping, relationships are established between the problem and potential solutions your team is trying to solve. Put your problem statement or high-level keyword in the middle of a piece of paper or whiteboard. Lines will be used to connect any related solutions or ideas raised by the team to the central theme. Link the proposed solutions to the previous layer by adding another layer describing how these solutions will be accomplished.

For instance, a small business owner could write that their social media engagement is low. Next, they might create bubbles representing approaches to improving user engagement, like producing quality content, scheduling postings, and exchanging direct messages. It is then possible to add a layer that outlines strategies for achieving those solutions, such as linking the ideas to the quality content bubble, posting more images, and sharing content from influencers and customers. It is possible to break down large ideas or problems into smaller, more manageable parts with the help of a mind map.

5. Brainwriting

An introverted participant can benefit from brainwriting as a version of brainstorming. Your team has five minutes to devise as many solutions to the problem you want to solve. Each person has a piece of paper. Following that time, the participants will pass their form to another participant, who will build on the ideas they had previously written down. A facilitator will then collect and display the papers once everyone has contributed.

Everyone will discuss each idea once it has been displayed and decide which one best meets your needs. You can now improve and develop these concepts further to make them more useful. This technique can allow everyone to contribute to the ideation process and have their ideas considered.

6. Questioning assumptions

Assumptions about how things should be done exist in many industries, but this method challenges those assumptions to create new ideas. This technique may be helpful when improving an existing product or creating a new one. Write 20 to 30 beliefs about the product, service, or idea you are trying to solve or create as a group. All aspects of your business should be covered by positive and negative assumptions.

The next step is to discuss these assumptions (or select a few, depending on time constraints) and determine whether they are true or have never been challenged. Afterward, your team may realize that certain assumptions weren't necessary, and you can substitute different, more innovative approaches.

7. Sketching

Sketching can be used to explore your ideas further when designing a product. Visual communication can help your team think about more abstract concepts since some people are more comfortable communicating visually than verbally. As long as they illustrate your ideas, rough drafts or simple sketches should suffice because they are not meant to be final images.

In collaborative sketching, participants draw ideas instead of writing them down. Afterward, participants build upon these drawings and present them to everyone for discussion. By analyzing the pictures together, you may be able to develop the best design solution. In addition, this method ensures that everyone's ideas are considered, which is a good option for more artistically inclined teams.

8. Analogies

Analogies are comparisons between two items or concepts, which can be used to generate new ideas. To simplify the problem, you are trying to solve, you can use an analogy. You can compare your situation to one everyone can relate to. You can use a template like this as a group:

In marketing, for example, an industry might be compared to fishing. In the same way, a marketing campaign has a target audience it is trying to reach; a fisherman needs to know what type of fish he wants to catch and what bait will attract them. Now they begin to brainstorm what kinds of "bait" they should use or which strategies will lead to quicker customer acquisition.

9. SCAMPER

In SCAMPER, you can approach a problem or project from seven different perspectives, enabling you to develop innovative ideas. A product or service already available can be improved or used as a starting point for a new one with this technique. Decide whether your answers represent viable solutions based on the SCAMPER elements. Finding solutions to products or services is possible if you look at them from these different angles.

10. Body-storm

Individuals are asked to act out situations as part of the body storing technique. A crucial part of design thinking is ideation, which focuses on user needs, and taking on the perspective of your potential user can help you think more empathetically about the situation. Participants can be energized and excited to generate ideas by using physical movement.

Using props in your scenario may be necessary if you are trying to generate ideas. Play out the processes or situations you wish to improve while generating ideas on how to achieve those goals simultaneously. By using bodystorming, participants can take a hands-on approach to potentially abstract problems. [9]

Proposed Methodology

Data model used to represent web resources. Subject, Verb, Object triples are used in the model. RDF triples are instantiated as statements. A resource or literal (string) can be an object. The subject is a resource or a statement. It allows us to express opinions about opinions. Schema for RDF data. Types for RDF are defined by the RDF Schema. Resources and properties can be defined according to a domain. A class, a property, and a constraint property are the most basic modeling primitives.
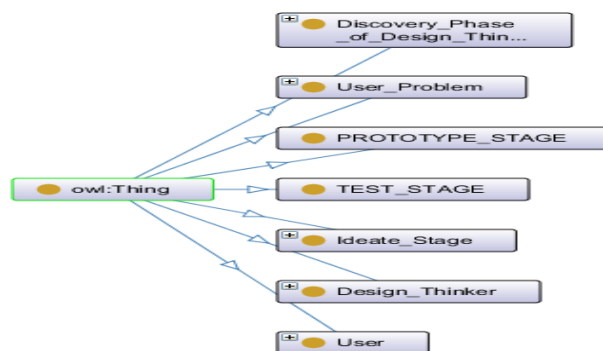

Fig 1: *OWL representing various entities and classes of Design thinking*

Ontology Web Languages are widely used in representing the knowledge base of the knowledge depiction for the data requirement. Concepts of Ontologies are executed in the Protégé editor. Various classes and entities are identified, and relationships are connected using the Object properties in the properties of the Domain and the Range of the subclasses and superclasses. RDF Triple and RDF schema is generated in the

Protege editor. Inferencing rules are computationally proven for the defined classes in the superclass. Design thinking is comprised of five stages, which are defined as the classes for OWL:thing the super class. Discovery phase of design thinking consists of Empathy and the define stage. Problem is defined by the user , design thinker notes the requirements of the user and for the problem to maintain the optimality in the reasoning solution.
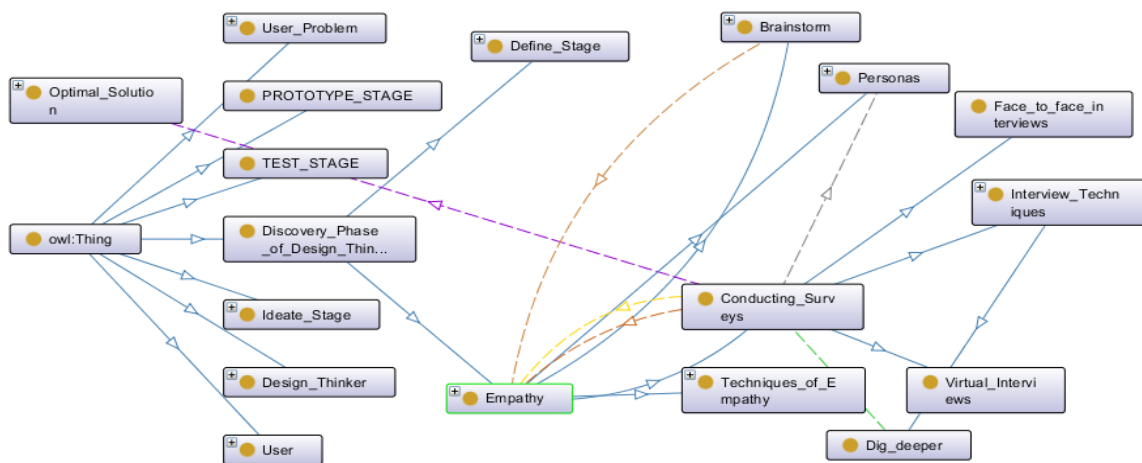

Fig 2: *OWL graph representing various techniques of the Empathy phase of design thinking*

Fig 2 explains the graph generating various classes of the Empathy stage, techniques for conducting surveys, to synthesize the framework for the define stage in the point of view statements.
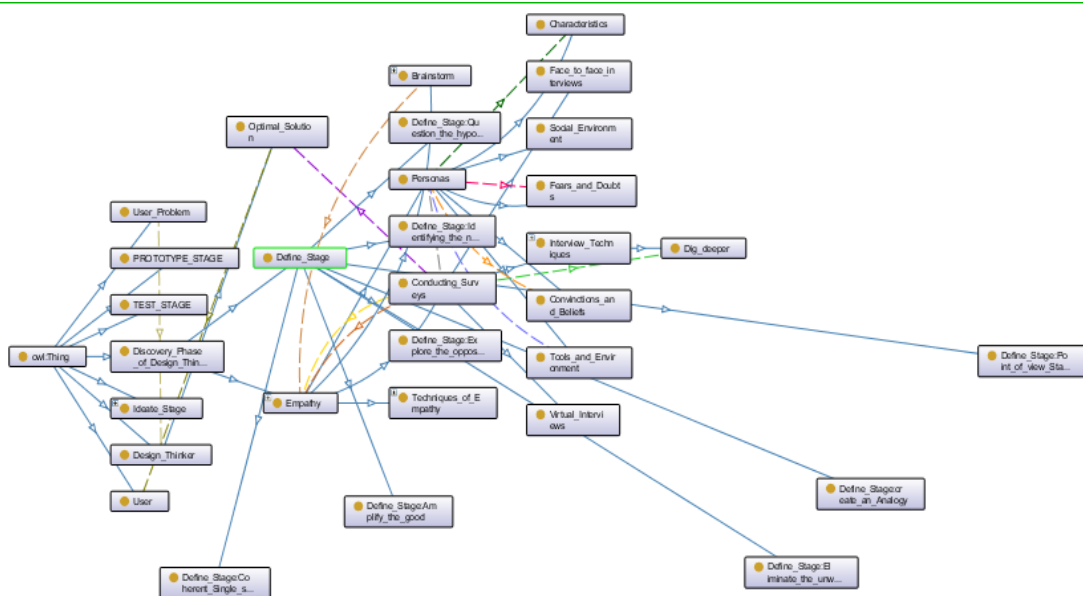

Fig 3: *OWL graph representing various techniques of the discovery phase of design thinking*

Fig 4: *OWL graph for the IDEATE and Prototype phase of design thinking*

Fig 5: *OWL graph representing Cognitive Design Thinking*
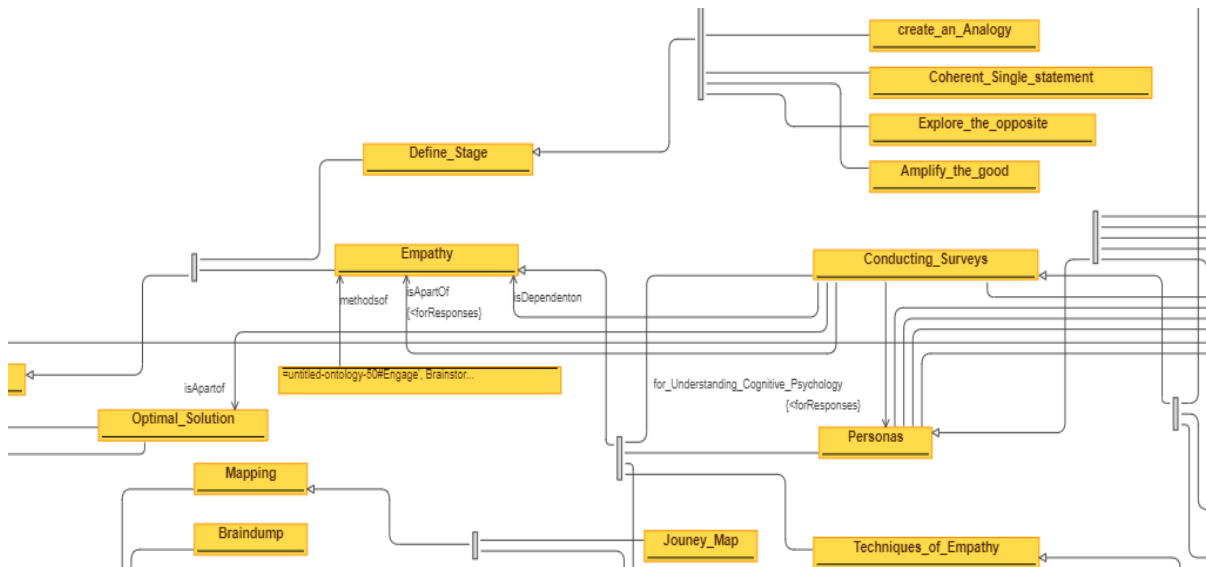
Fig 6: *Sample OWL graph representing Objects and relations for CDT*

Relationships between classes and the entities are defined based on the Object properties and can be visualized using the OWL grEd.

Results and Discussions

From the above OWL-based graphs in the protégé editor, different stages of CDT are implemented by illustrating various techniques in the design thinking process. Conducting surveys, interviews, interactions, and responses from stakeholders is essential at the primary stage: Empathy in the design thinking to understand and define the problem. Once the design thinker defines the point of view statement, they apply many techniques in the ideate stage and conclude with the optimal solution through the principle of optimality. Ontologies enhance the relationships between the identified classes and objects in the CDT process, developing Semantic-based approaches using descriptive logic computationally. Intelligent systems can be built for the CDT process based on the generated graphs in the future.

Conclusion and Future Scope

In this paper, Different stages of CDT are implemented using the OWL in the protégé editor. Various classes, entities, and objects are identified, and the relations are built between the tools' entities. RDF schema is generated. Results prove that empathy is the primary factor for designers to solve a problem using design thinking techniques. The ideate stage is the CDT process's core heart, which enhances and enables solving and converting the requirements to the methods through mind-mapping. In the future, CDT can be extended to generate Inference rules in the protégé editor by proving DL and SPARQL are used to retrieve the data from the OWL: Thing to Subject-> Predicate-> Object.

Acknowledgment

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