Role of Ontology in Automatic Construction of Stories for Kids

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Abstract - **Story is a description of a chain of events told or written in prose or verse. It gives an excitement for the people in the world irrespective of their age and it is an interesting way of transferring knowledge from one person to other in the form of narrated sequence of events arranged in a chronological order to convey the message. In the artificial intelligence era, construction of stories by the system has the significant role in natural language process. Constructing the stories automatically by the system is significant in the artificial intelligence era. Most of the story generation models have concentrated on syntactic level rather than semantics. Syntactically constructed story may lose their interestingness. To provide the semantics for the constructed story, ontology has significant role. Ontology is a formal explicit shared conceptualization, which is used to provide the domain knowledge. This paper focuses on reasoning the sentences to check the semanticness of the constructed story using ontology.**

Keywords Ontology; Story generation; Reasoning; Information retrieval;

I. INTRODUCTION

Everyone in the world have their own interest to read the stories and like them very much. Stories are naturally has their own way of attraction from children to old age people. Children learn their moral and social obligations in the form of stories narrated to them by their guardians and peers [1]. It is a natural language description of objects, their attributes, relationships, beliefs, behaviors, motivations and interactions. The generic act of reiterating knowledge and transmitting it in a targeted manner for human consumption is known as knowledge transfer. Story telling is one of the forms of knowledge transfer. There are various ways to express the stories or transfer the knowledge like story writing, story telling, animation and etc. Here, a story can be generated in the form of text, which is in simple English language.

A Simple Story is started with initial situation and which has an active element to precede the story interestingly and finally comes to final situation. Our project discusses about the automatic construction of stories using ontology for kids. The Ontology specifies the rich description of terminology, concepts, relation between concepts and rules relevant to a particular domain. The story ontology preserves the concepts, instances and relation of the story domain. Actually, there are many systems that aim to create new stories automatically. All of these systems use a different methodology and usually they are very difficult to compare or evaluate. Many systems reuse a couple of main plots and only change secondary elements of the story world; sometimes that is enough and the story seems different to the reader.

The automatic generation of stories needs certain types of representation for theme structure and how it is built up from primitives, a computational solution to generating stories from the user input, and the choices of some format for presenting the resulting theme that is easy to understand and to generate the stories in a neat fashion. Ontology has taken vital role in conception of themes and generation of stories. Ontologies are now being recognized as important components of information systems and information processing. Ontology is a formal explicit specification of shared conceptualization. It can be expressed as the basic terms and relations comprising the vocabulary of a topic area as well as the rules for combining terms and relations to define extensions to the vocabulary for a specific domain. The ontology is constructed based on the components of story domain. It involves characters, location settings like forest, palace, home and etc. The ontology posses the events and the order of events/ functions /activities leads the story generation system. Even though constructed ontology is domain specific, it can be updated, modified, reengineered, reused for other purposes also. The main reasons [2] for using ontology for story generation system is

- To share common understanding of the structure of information among people or Software agents
- To enable reuse of domain knowledge
- To make domain assumptions explicit
- To separate domain knowledge from the operational knowledge
- To analyze domain knowledge

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Ontologies are one of the essential components of the reasoning process used for information management and for the presentation of information. Users' access to information and the presentation of information to users are both mediated via natural language, and the Ontologies used in the reasoning component are coupled with the lexicon used in the natural language component.

Section 2 discusses about the related works in the field of ontology reasoning. Section 3 provides the details of automatic story generation system. Section 4 elaborates the role of ontology in automatic story generation system and their reasoning tasks. Section 5 and 6 discusses about the implementation issues and conclusion.

II. Related works

Dominique Estival et al proposed the hybrid approach of the Natural Language Processing (NLP) and the Knowledge Representation and Reasoning (KR) work packages are tasked with providing appropriate NLP and KR functionalities, including processing natural language queries and providing a formalization of the domain and reasoning capabilities. FOCAL (Future Operations Centre Analysis Laboratory) project is to provide the FOCAL users with automated knowledge management and with automated reasoning capabilities about a complex domain. Ontologies have been chosen as the type of representation most suited for this task, and the provision of ontological reasoning capabilities has been one of the main thrusts. The FaCT and RACER reasoning agents were used to provide reasoning facilities, FaCT during the building of the ontologies to ensure coherence and consistency, and RACER at run-time. When integrated within the FOCAL system, the RACER server can be initialized with a given ontology and there is a RACER client wrapped as a CoABS agent on the grid, which can connect to the server [3].

Federico Peinado et al provide the method for using ontology in automatic story generation system for propp's function. The combination of resources like Ontologies and inference formalism such as Description Logics has proved very useful for generating semantically correct texts. The development of an OWL ontology based on Propp's Morphology of the Folk Tale oriented towards automatic story generation. The ontology is designed so that it allows measurement of the semantical distance between narrative functions [4].

Ong Siew Kin et al discussed the reasoning with ontology in a neat fashion. The Reasoning tasks involving individuals, who are called assertion reasoning, are:

- Realization – given a partial description of an individual, find the most specific concept that describes it.
- Instance checking – given a partial description of an individual and a class description, finds whether the class describes the instance
- Individual retrieval – finds all individuals that are described by a given concept [6]

Reasoning checks for concept inconsistencies, hidden dependencies, redundancies, and misclassification and derive implicit relationships during development of ontologies. While deployment, it is useful to answer queries as well as doing classifying. He discussed the importance of reasoning the ontology and their use. Ontology reasoning helps for the automatic story generation in terms of changing their places, characters, and roles in the story.

III. Automatic story generation system

The automatic story generation system has two levels, such as knowledge level and process level. In the knowledge level, the system should be provided with intelligence to extract the knowledge from the domain. The purpose of ontology is fully utilized here. The theme conception for a new story is major task in which the theme consists of ordered collection of events. In the knowledge level phase, entire domain knowledge is structured in such a way that making the information extraction, verification as easier one. In the process level, the computational aspect of language generation for story generation is considered. The Simple sentence grammar or the language grammars utilized for constructions of sentences are given below.

S → NP VP
NP → Datum Noun
VP → verb PP
PP → prep NP

Application of the sentence grammar recursively the sentence can be generated as

Sentence = datum noun verb prep datum noun/pronoun.

For example, The Crow slept in the nest

Ontology provides the background knowledge required by the system as well as related information about characters, places and objects of our story domain. It contains the descriptions and properties of the characters and their role-played in the story. Each and every character is defined by a set of relationship with other characters, object it posses, location and their habitats, which are all represented in the domain ontology. The ontology acts as information provider for the generation of meaningful sentences in the story.

For every story generation, theme has the vital role in generating the stories in an interesting manner. Conception of the themes may be classified as

1. Author's intention
2. Reader's expectation

Stories are generated based on the author's perspective mind and their creativeness. Based on the author interest stories may ends with comedy or otherwise it may ends with tragedy whereas if the stories are generated as per the reader's expectation, then the flow of story may loose their interesting. Because the reader's will understand the story and they will guessed the next line of the story well which reduces the interestingness for reading the story. Ontology has the library of functions or moves or events, which are used to lead the interestingness of the story. The grammar for story generation is given below:

Story → Setting + Theme + resolution
Settings → Characters+ Location + Time
Theme → (Event)* + Goal
Resolution → Event* goal

Each moves or functions in the event ontology, ordering the same may leads to theme conception for generation of stories. Vladamir propps [ ] has classified the Russian tales in to 31 functions. Selection of functions may yield a story in the end. The redundant patterns of sentences make the story as an uninteresting one. Revision of sentences required which are already exists in the library. Sentence planner module has the random way of constructing the new sentences, which form the story.

IV. Ontology in Story Generation

Nowadays ontologies have taken vital role in information processing. They are important for story generation, which holds the various concepts relevant to the story domain. Initially, the ontology built with minimal knowledge, in later stages, ontology can be extended whenever new concepts are introduced. One of the primary purposes of constructing ontology is to provide a standard, unambiguous representation of a particular domain of knowledge. It is not a new issue since there are ontologies being used in the computing environment.

The Layers of story generation are fabula the lowest layer, Story is the middle layer and the narrative is the top layer. The Fabula describes the objects and events and their chronological interactions, the Story that describes their arrangement for a purpose, and the Narrative that describes how this is realized in a particular media or form [5]. Since Ontology posses the collection of events, moves and the character actions for the information processing it enables to provide the semantic coherence between the events and the characters. The sub ontologies provide the sub concepts to cover additional domain knowledge related to story domain. To extract the knowledge from ontology, we need to reason the same for the appropriate extraction.

A. Reasoning using ontology

Reasoning is the cognitive process of looking for reasons for beliefs, conclusions, actions or feelings. It is very important during ontology development and deployment. It checks for concept inconsistencies, hidden dependencies, redundancies, and misclassification and derive implicit relationships during development of ontologies. While deployment, it is useful to answer queries as well as doing classifying [6]. Reasoning uses ontology to check the semanticness of the generated story. The main reasons for design and maintain high quality ontologies for reasoning story are as follows:

- Meaningful—all named classes can have instances
- Correct—captured intuitions of domain experts
- Minimally redundant—no unintended synonyms
- Richly axiomatic—(sufficiently) detailed descriptions
- Find more general/specific classes
- Retrieve individuals/tuples matching a given query

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Ontology is "formally defined" which is a precondition for a computer to interpret it. Rules can be used to infer the knowledge from the ontology. Typical elements of ontologies are:

- Concepts and its attributes
- Taxonomies to categorize concepts by generalization and specifications
- Relation between concepts
- Axioms to define statement, which are always true. They are used to prove the consistency of the knowledge modeled by an ontology and to deduce further facts
- Individuals are instances of concepts in relation

B. Methods of reasoning ontology

Description logics are knowledge representation languages tailored for expressing knowledge about concepts and concept hierarchies [7]. The basic building blocks are concepts, roles and individuals. Concepts describe the common properties of a collection of individuals and can be considered as unary predicates, which are interpreted as sets of objects. Roles are interpreted as binary relations between objects. [8]. Description logic defines a number of language constructs (such as intersection, union, role quantification, etc.) that can be used to define new concepts and roles. But OWL has the language expressive representative formalism and reasoning power. Because OWL was derived from DAML+OIL, it can take advantage of the existing reasoning algorithms in Description Logics (DL).The main reasoning tasks are.

- Satisfiability of a concept - determine whether a description of the concept is not contradictory,

i.e., whether an individual can exist that would be instance of the concept.

- Subsumption of concepts - determine whether concept *C* subsumes concept *D*, i.e., whether description of *C* is more general than the description of *D*.
- Consistency of ABox with respect to TBox - determine whether individuals in ABox do not violate descriptions and axioms described by TBox.
- Check an individual - check whether the individual is an instance of a concept
- Retrieval of individuals - find all individuals that are instances of a concept
- Realization of an individual - find all concepts, which the individual belongs to, especially the most specific ones

The semantic of OWL allows us to define a ranking function that distinguishes multiple degrees of matching. There are three types of matches: exact match where the concept to be found is found, plug-in match where the concept to be found is more specific than the concept in ontology, and subsume match where the concept to be found is more general than the concept in ontology. The scoring function of matching degree is given below [6]:

Exact Match > Plug in Match > Subsume Match

This matching degree helps to identify the semanticness of the generated story. For example, if the sentence generated for story is "**Rat killed the lion**", the sentence is parsed to ontology to obtain the basic properties of rat and Lion. The basic properties of the Lion is

Living being → animals → wild → Lion (king, legs, anger, roar, kill)
→ Domestic → Rat (small, legs, frightens)
→ Bird → crow (black, legs, fly)

Based on the ontology reasoning, the semantic checker will give the recommended report as "**Rat killed by the Lion".** So the basic properties of Lion and Rat are preserved. The way of reasoning the stories by applying the logic is given below:

Wild → Lion
Lion → roar
Lion → kills (birds, animals)
Bird → crow
Crow → fly
Crow →¬ kill (animals)

Fig.1 shows the automatically constructed story as per the user requirement and the semantic checker recommends changing the sentence to make it meaningful. For example in story generation system, the sentence may be generated for story as "*Crow killed the Lion"*. The semantic checker of the story generation system validates the sentence based on the logical inference. Finally, it recommends the sentence as "*Crow killed by the Lion* "or "*Crow could not kill the Lion*". Based on the situation or flow of the story, we have to select the suitable sentence to make the story as an interesting one.

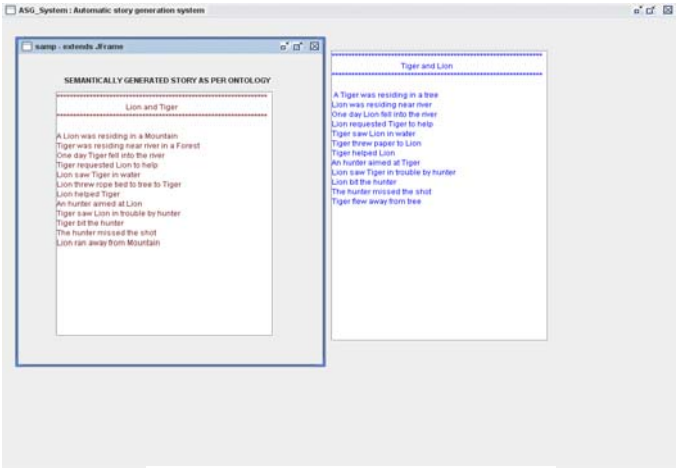

Fig. 1 semantically corrected story

C. Ontology development tools

Protégé tool is used for construction of our ontology for the story domain. It provides extensible knowledge model to enable users to redefine the representational primitives. Using Protégé tool the ontology is constructed and the owl file is generated. This file is then parsed using Jena parser for owl parsing which helps in identifying the class subclass relationships. The extracted knowledge from ontology is the input for story generation phase where the generated story will be checked for semantic correctness of each sentences based on domain ontology concepts

V. Experimental Results and Discussion

The experimental results have been considered for the appropriate retrieval of concepts and sub concepts from the ontology for the sake of semanticness in the story. Since the story ontology has many concepts and relations, which are needed to be fetched from ontology appropriately. Checking for the unavailability of terms or concepts from the base is mandatory. The ontology was tested for the retrieval of terms with accuracy. Out of 120 number of testing, the details about the retrieval of terms are listed below: 54 attributes are retrieved appropriately (exact match), 42 are approximately retrieved and 24 are retrieved not relevantly or saying that the search is unsuccessful. Table 1 Shows the results obtained from the constructed ontology.

The Exact match retrieval can be improved by concentrating the retrieval of terms with their synonyms and their semantic. The semantic retrieval of terms or concepts from the ontology helps for improving the accuracy of semanticness in the story generation system. The ontology can be enhanced further by considering the terms and their semantics efficiently.

TABLE I

RESULT OF THE TERMS RETRIEVED FROM ONTOLOGY

S.No	Nature	No of terms attempts	No of retrieved terms	% of retrieval
1.	Exact	120	54	45
2.	Relevant	120	42	35
3.	Unrelated	120	24	20

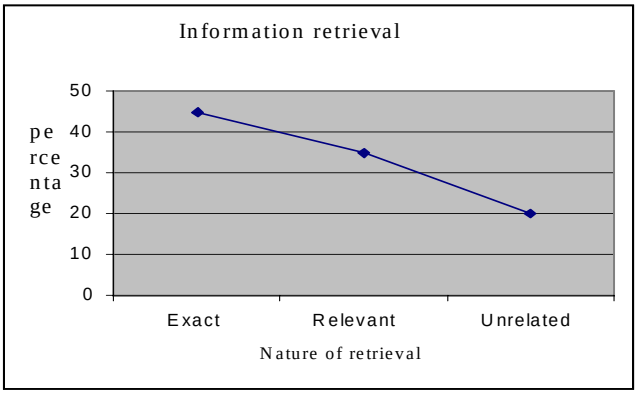

Fig.2 Graph for information retrieval

The Fig.2 graph depicts the information retrieval from the ontology with three basic features namely appropriateness, relevant, unrelated retrieval. Inclusion of more number of concepts helps to retrieve the same appropriately.

VI. CONCLUSION AND FUTURE WORK

The semantic checker can validate semantics of story in the automatic story generation system using ontology. Performance can be improved by extending the ontology with more number of concepts and the attributes. Even though Ontology has the provision for extending with new concepts, Ontology alignment is also crucial for reusing the existing ontologies and for facilitating their interoperability. In future, the domain ontology has to be enhanced with widespread information and the reasoning should be concentrated on deriving tacit knowledge from the axioms, which helps to improve the semanticness of the story. By concentrating these two factors, automatic story generation system can be enhanced with interesting ones.

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