Ontology Based Information Retrieval for Learning Styles of Autistic People

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Abstract. In this paper an ontology based prototype system for information retrieval on the Internet is described. User is interested in the focused results regarding a product with some specific characteristics. A product may have different characteristics like size, length, color, functionality based parameters etc. It is, however, difficult for autistic people to identify appropriate keywords due to their lack of ability to process and retain the information. Therefore, a large amount of unwanted and irrelevant data is included in the outcome. In this proposal user may type the search queries using some words. The objective is to find the right set of keywords from the search paragraph and retrieval of correct patterns or products from the web. This is based on memories of such people and their learning styles that help them find the desired result.

Keywords: autistic, information retrieval, ontology, semantic web.

1 Introduction

Information retrieval (IR) is the area of study concerned with searching for documents, for information within documents, and for metadata about documents and finding material of an unstructured nature that satisfies an information need from within large storage [1]. IR is also used to facilitate semi structured search such as finding a document where the title contains Java and the body contains threading and clustering which is the task of coming up with a good grouping of the documents based on their contents. An information retrieval process begins when a user enters a query into the system. Queries are formal statements of information needs, for example search strings in web search engines. In information retrieval a query does not uniquely identify a single object in the collection. Instead, several objects may match the query, perhaps with different degrees of relevancy. Today's technologies are advancing the way we learn and communicate. With innovative tools, autistic people can read books, play games, and communicate with computers. New technologies are being developed to understand the special needs of such people. The motive here is to look for easy ways for these people to access electronic information and more importantly information retrieval on the web.

'Learning styles' is a concept which attempts to describe the methods by which people gain information about their environment and that help someone learn and retain a skill or fact. Some individuals believe that spatial methods are the only way to

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go with autistic children whereas some believe that the only way to deliver skills training is by utilizing words. The predominantly used learning styles are: Visual (spatial), Aural (auditory-musical), Verbal (linguistic), Physical (kinaesthetic), Logical (mathematical), Social (interpersonal), Solitary (by self). For example, viewing a book of pictures or reading a textbook involves learning through vision, listening to a lecture in a classroom or on tape involves learning through hearing, and pressing buttons to determine how to operate a computer involves hands-on learning [2].

Various user friendly and efficient tools were developed for the assistance of disabled people such as Graphical User Interface (GUI), which was developed by Douglas Engelbart [8], a talking typewriter for blind people, a talking display terminal, a screen reader for the sight impaired, a speech recognizer (Via Voice), a talking web browser (Home Page Reader) which were developed by IBM and many assistive tools were developed by Microsoft [9], [11].

User is interested in the focused results regarding a product with some specific characteristics. It is, however, too difficult for autistic people to identify appropriate keywords due to their lack of ability to process and retain the information. Therefore, a large amount of unwanted and irrelevant data is included in the outcome. The proposal handles the search queries related to the autistic people based on their learning styles. The information system can identify desired keywords for the query that have strong relationships with ontology in their learning styles.

2 Information System for Autistic People

Autism is a lifelong developmental disability that first appears during infancy or childhood, and generally follows a steady course without remission. It affects how a person communicates with, and relates to, other people. It also affects how they make sense of the world around them. Overt symptoms gradually begin after the age of six months, become established by age two or three years, and tend to continue through adulthood, although often in more muted form. Autism interferes with the normal development of the brain. The three main areas of difficulty which all people with autism share are sometimes known as the 'triad of impairments'. They are: difficulty with social communication, difficulty with social interaction, difficulty with social imagination.

Difficulties concerning communication are like immature language skills, communication with gestures, not able to understand the facial expressions or tone of voice, inability to attach meaning to words etc.

As for difficulty with social interaction, individuals with autism prefer to spend time alone rather than with others, doesn't understand the unwritten social rules, are less responsible to social gestures such as eye contact, are insensitive to others feeling and are anxious.

As for difficulty with social imagination is concerned it is hard for autistic people to comprehend abstract ideas, understand the concept of danger, solve problems on their own, distinguish between right and wrong, imagine and plan for future.

Many problems that autistic children experience can be alleviated through special education. The main goals when treating children with autism are to lessen associated

difficulties and to increase quality of life and functional independence. No single treatment is adequate and is typically tailored to the child's unique needs [3].

Based on above difficulties it is realized that autistic individuals are more likely to rely on only one style of learning. One way to improve these children's lives is to introduce learning tools called Augmentative Communication. This technology provides visual information in a creative format which helps a child in completing activities of daily living both in the home and at school. For example, an Activity Schedule can be created to remind the child what they have to do when they wake up to get ready for school. The morning routine can be represented using various photographs, drawings or words placed sequentially. Eg: Page 1: a toothbrush and toothpaste; Page 2: a washroom; Page 3: a hairbrush; Page 4: a shirt, pants, socks, and shoes; Page 5: a bowl of cereal and milk; Page 6: a backpack, lunch box, bottle. After completing each action it's important for the child to cross off the item or place the picture in an "all done" envelope. When the information is presented in this way it helps the child understand the sequence of daily events.

As can be inferred from the work of many researchers (such as [4, 5, 6]), individuals with autism think in pictures, not words, and play a video in their mind when reasoning. Below is the pictorial representation of phases of an eating event.

Fig. 1. Phases of an eating event

One of the most remarkable mysteries of autism has been the magical ability of most autistic people to perform outstandingly at visual spatial skills while performing so poorly at verbal skills. Visual thinking enables them to build entire systems in their imagination. They prefer to use diagrams, pictures and movies to see the information they are learning. Temple Grandin, an architect with autism, often says that she can translate both spoken and written words into full colour movies, which run like a movie in her mind [3].

From the above explanation we can see that, for autistic people to remember something, they must first recall when and where the event happened, and then identify it. When they are searching for something with Web information retrieval systems, they need to recall memories of the events already occurred in the form of sequence of images or a short movie and use them for their search.

Autistic children are motivated by imagination and consistency which is why computers are the perfect assistive technology tool for learning. They put the child in

the driver's seat and make them learn to function independently. Research has found that students with Autism who use computers have increased attention spans, can stay in their seats longer, develop improved fine motor skills, and show greater ability to generalize skills across environments by repeating a wanted behaviour at home that was learned at school. Moreover computer games can help children with autism in educational areas such as learning new vocabulary, practicing math skills or improving eye-hand coordination. Due to the enormous benefits computers can provide, they should be an integral part of a special education student's daily curriculum.

The "Autistic Learning style Ontology" consists of various events in their lives in the form of entities and information regarding those events as annotations. The retrieved events that occur in autistic people's daily lives are stored as subclass information of the event class. Therefore, by asking the child when and where the event happened, and by showing images related to the events the system can infer which kind of event happened to the child. Such questions asked of the child can help them to discover the queries and get the desired results. Below (Fig 2.) is a section of the "Autistic learning style Ontology" which presents various games for autistic people.

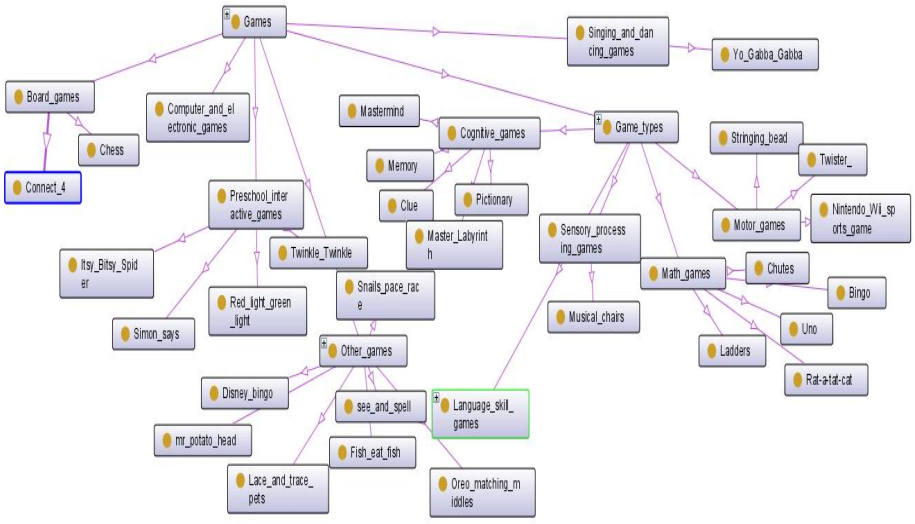

Fig. 2. Autistic learning style Ontology graph

3 Semantic Information Retrieval Process

The Semantic Web combined with ontology can be used for visualization techniques in several different ways, but the visualization is dependent on characteristics of the ontology used. Ontology helps both people and machines communicate more effectively by providing a common definition of a domain. The GUI serves as an interface between the user and the system.

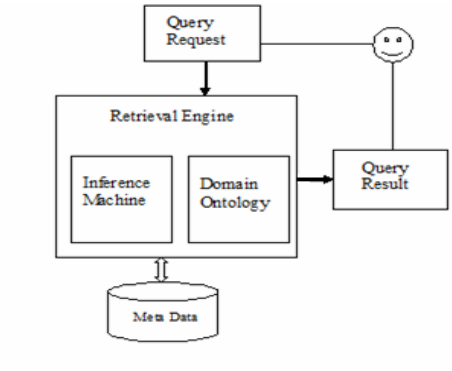

Fig. 3. Semantic Information Retrieval system

A web retrieval process is discussed in this section. Imagine this scenario. An autistic child Bunny aged 9 wants to play a game “reader rabbit” which he saw his friend playing on his computer a day before. He doesn’t know the name of the game but know the name of the character “rabbit”. If he search that term in any search engine, the results presented are hardly helpful. There are listings for animals, Chinese zodiac sign rabbit, web proxy mixed into the results. Only after sifting through multiple listings and reading through the linked pages will he be able to find the exact thing he wants. But being an autistic child he is not able to do this.

However, in a Semantic Web-enabled environment, you could use a Semantic Web agent to search the Web for “reader rabbit”. The following are interactions between bunny and the web Agent:

1. Bunny inputs "rabbit" as a search keyword. The resulting data include many irrelevant pages such as animal, zodiac etc.
2. Agent: "Where did you see rabbit?"
3. Bunny inputs "game".
4. The system collects a set of character names in popular games on the Web.
5. Agent: "You are searching for Reader Rabbit in which a rabbit with blue and red striped sweater plays?
6. Bunny: inputs "Yes."
7. Agent: The system dynamically finds the keyword "Reader rabbit" in the “Autistic Learning style Ontology." The subclass hierarchy consists of "Games," "Game types," "Language skill games" and "Reader Rabbit".
   Agent: "Would you like to play the game Reader Rabbit?"
8. Bunny: inputs "Yes"
9. The agent starts the game on the computer and tells him about the rules of the game.

4 Conclusion

The Semantic Web provides a futuristic approach to the web. In this information is given explicit meaning, making it easier for machines to automatically process and integrate information available on the Web. The main problem with the existing

ontology is that it does not provide the latest information because it is static and fixed, no new data can be added to it. Whereas this "autistic learning style Ontology", can be modified and enhanced taking the latest information from various sources related to the autistic people. E.g. Blog's written by mothers, teachers of autistic children and from the web. This ontology is to help autistic people retrieve information about the various events happening in their lives and their learning styles. When children want to search for something, they use memories and sequence of images in the form of a video or a short story to express what they want. To identify the right query, their unique and special ways to express things needs to be understood. By using this "autistic learning style ontology", it is expected to better understand their needs and learning styles.

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