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Ontology based disaster prediction using Animals behavioral changes

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ABSTRACT

Mother Nature's blunt and brutal punishment on neglecting or taking for granted her incomparable and exhaustive recourses by either destroying or excessively damaging it. When we make mistakes there should be a person who corrects us in the context of what spoken it is the wrath of Mother Nature to be dealt with. Natural disasters are not of the past but more of the future with regularly occurring phenomenon's or occurrences which need to be dealt with utmost care and top of priority in list or else existence of human race will be on the brink. The need of hour is one discussed as the basic theme of this paper and being equipped with all possible ways to prevent an exodus of human grave. This paper emphasizes on creating various classes and subclasses and build properties and operations on these classes of which some of the properties which would exactly differ on its functionality aspect of the ones actually intended to be. The behavioral changes would be reflected if there is execution of certain behavioral traits in an object which is well evident from the original one. The classes and subclasses and various other attributes and values will be designed using protégé tool. And later relevant DL queries can also be applied over it to observe any from any changes exhibited by objects of each class.

Keywords: Semantic, Ontology, RDF, Natural Disaster, Class, behaviors..

INTRODUCTION

When the word called tsunami, earthquake or a volcanic eruption is pronounced the better talking people would be the one on the receiving end. On thinking about an event in which you are really relaxed on one of the Goa beaches and enjoying the calmness and cleanliness around it, just in a moment of time when the sea pulls in the water and you are in awe of what kind of game played on you? Just kindles in you what is about to happen next with a giant wave of 20 to 30 feet high to sweep you off your beach mat is not a simple think to imagine or dreamt off, as there would be no point of escape from what is going to occur.

Japan one of the most affected countries through natural disasters because of its positioning has taken plenty of steps to combat any kind of situations and coming out of it too. Plenty of oceanographic concepts have been applied in placing sensors which detect in any movement under the ocean which will trigger an alarm before in hand for mass excavation of people and preparation. The month of August 2014 witnessed one of the strongest earthquakes measuring 6.9 on Richter scale killing 614 people. If you have ever wondered on the marvel of how animals are least affected in such situations as they have a entirely different way of foreseeing certain events to occur well in advance weather it is migration of birds or elephants occupying an higher ground are certain examples which could be mentioned. Any type of natural disasters such as floods, volcanic eruptions, earthquakes, tornado and wind storm affect millions of people every year. According to recent statics, the year 2014 saw a whopping 14 thousand odd natural disasters which have occurred. Any natural disaster for that matter may cause a great loss of life or damage in livelihood.

Amongst the most consistent abnormal behavior which has been reported comes from dogs. In one such event which occurred in china in 2014 dogs showed varying behavioral changes which includes restlessness, biting owners, hiding in a secure place brought in plenty of talking points and researching in seeing weather these behavioral changes what occur is it because of an event or else. What has amused researches is whenever such events occur animals are always in news for what changes were observed by owners before the event occurred. In another such event birds migrating for the breading season is completed also is a clue on what is going to happen at the point of time.

Our research idea is on how take a decision based on certain behavior changes exhibited by dogs. The concept used here is semantic web ontology. The concept of object oriented programming has very much relevance to outside world as it can be related to any system at ease because it emphasizes on Classes, objects and various other common characteristics of Object oriented concepts. Our concepts too revolve on creating a class called as Dog and observing the behavioral traits and changes in relevant objects. The basis of the object-oriented approach is as good as possible a representation of something that really exists in the real world. However, this representation will never completely correspond to reality. Almost everything in the real world, whether it is a living being, an object, or an idea, is so complex and has so many aspects, that this complexity can never be completely represented. Real World Modeling can be easily accomplished using Object Oriented Programming. And semantics and help us model it better. In real time we always deal with objects such as people, animals,

vehicles, buildings. Such objects aren't like data and they aren't like functions. Any real world object taken is really complex by nature and any object will have two prominent concepts involved which are attributes and behavior.

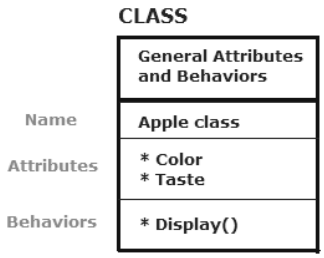

Fig.1 Class Attributes and Behavior

METHODOLOGY

Application of ontology has seen a phenomenal growth and a source of great potential for further path breaking innovations, ontology modeling and reasoning has become one of the active areas in the field of ontology-based systems. There has been a great deal of research which has been done for disaster prediction and analysis, and has made progress in the field of disaster forecasting. However the traditional and the existing approaches focus only on classical statistical methods or expertise judgment, which do not include any form of semantic-driven approach and intelligent reasoning. With the prominent development and usage of ontology theory and technology, a new approach is put forward in this paper, which aims at better analysis of natural disasters. After observing and analyzing the behavioral changes in dog's and their relationship in the field of natural disasters, a domain ontology model of some disaster could be created, which later is used to mine the hidden influencing factors or disaster chain information by using inference machine with domain-specific rules. It will be of great significance to build an ontology driven disaster prediction and information system to predict and mitigate people early before a disaster occurs in reality. And the papers main focus would be revolving around it.

There is something called as olfactory senses in any living creature while humans process 500 Dog's olfactory senses are 10,000 to 100,000 times stronger than humans possess, this may give them the ability to smell a change in the air before storms and earthquakes. And how can we have the concept of behavior changes of the particular class can be easily related to the relationship established between class and related objects and attributes and behavior exhibited by a class.

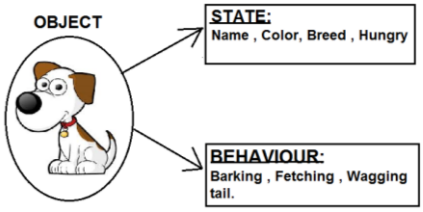

Fig. 2 Object Dog with state and behavior.

In Figure 2 we see the states or attributes of an object called Dog and associated behaviors.

Representation of Ontology and Reasoning

Resource Description Framework (RDF), Web Ontology Language (OWL) and Description logic (DL) are the three ways to represent ontologies. OWL is an extension of RDF and a machine-readable language for sharing and reasoning information on the Web. But by just representing ontologies in any of the form, there won't be any significant conclusion which could be drawn; in our case the decision taken should be fast and accurate. Reasoning is one way to derive to new facts which are not expressed in ontology or which is present in a knowledge base on an explicit note. Hence inference engine came to existence which provides a richer set of mechanisms which by using asserted facts and axioms can infer a logical consequence in a system.

RDF (Resource Description Framework)

It is the data modeling language for the Semantic Web. All Semantic Web information is stored and represented in the RDF. In is the simplest level, the RDF is an XML based language to describe resources. The RDF model is often referred to as a triple because it basically made up of three parts, subject, predicate and object. One way to think of an RDF is as "anything that has identity". Unique URI can be assigned to a word which is synonym to another such as tree bark and bark was loud.

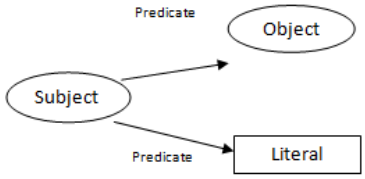

Fig.3 the RDF triple

OWL (Web Ontology Language)

Ontologies are more about vocabularies and their respective meanings. Ontologies extend the concept of taxonomies. Ontologies not only give 2 Dimension semantics but add on another Dimension to greatly improve on a more detailed format. Ontology is created using the ontology management tool called protégé. The ontology is made up of classes of any particular system which we need to design and in ontology terms they are called as concepts as they correspond to the mental concepts that human beings have when they try understanding a particular body of knowledge or subject matter or domain.

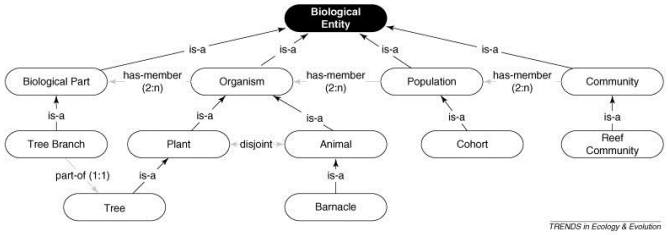

Fig. 4 Ontology depicting Biological entity.

The major components of ontologies include:

- Individuals: Which are also termed as instances or particulars would be considered as the base on which ontology would be defined. These are the actual things which are described by ontology.

- Classes: Without classes ontology cannot be described as it encapsulates the class name its attributes and attribute values and various operations which the class carries out.
- Attributes: attributes describe the features or properties exhibited by the class.
- Axioms: In terms of mathematics or computer science axiom is considered a statement which is accepted as true without any evident proof. Hence axioms can be a really useful concept in situations where in a conclusion can be drawn on particular statement which needs no more or none of an evidence for the concept or event to be considered true. It can be also considered as a self-evident and universally accepted truth. For example in our case study the attributes and operations can be related with various axioms on the particular class called Dog's and the statements derived out of the class has to be considered true through its axioms.
- Events: They are something which are actually occurs or happen or take place.

As we have described various component of ontology, the main or major content of OWL ontology always lies in its axioms and facts, which are the main provider of information about classes, properties and individuals in the ontology. Hence the axioms and facts should be clearly and completely defined.

There are three very expressive sublanguages that are provided by OWL,

- OWL Lite
- OWL DL
- OWL Full

OWL Lite supports simple constraints and classification.

OWL DL supports complete expressiveness while keeping in mind the computational completeness and decision making while conclusions are guaranteed to be computable and will finish in time.

OWL Full provides users with maximum expressiveness and syntactic freedom of RDF with no guarantee on computational issues.

Introduction to Reasoner

Developing and using ontology which is written in OWL is the primary objective of a reasoner. Automated reasoners, such as Jena, FaCT++, HerMit, ELK etc. which take on the axioms written already in OWL and offers group of operations on ontology's axioms. A reasoner does a whole lot more what offered in Protégé. Classification is one of the main objectives what reasoners are used for. Let us assume the ontology created by us is termed as Animal which includes statements and parsing the contents of all relevant OWL files. We must also know all the class names which occur in axioms in Animal: let's call this set A (for names). When asked to classify Animal, reasoned does the following tasks:

First checks whether there is a model corresponding to that of Dog and whether there exists structure that satisfies all axioms in Dog. For example, the following ontology would fail this test since Dog cannot be an instance of two classes that are said to be disjoint, i.e., each structure would have to violate at least one of these three axioms:

Class: Animal
Class: Natural Disaster
Individual: Dog types: Animal
Individual: Dog types: Natural Disaster
Disjoint Classes: Animal, Natural Disaster.

The reasoned returns a warning message quoting "this ontology is inconsistent", when the case test fails, if the case test is passed, the classification process continues to the next step. The warning message is handled differently in different tools.

CONSTRUCTION OF DOMAIN ONTOLOGY

According Gruber principle ontology modeling has to adhere to Clarity, Coherence, Extendibility, Minimal encoding bias and Minimal ontological commitment. Building an ontology has to be in a methodical or stepwise way. Firstly, we determine the scope and object of the domain ontology. Then we analyze which language is well suited to describe and represent the domain ontology. Later select a sophisticated and efficient tool for ontology development. Once the tool is selected the next step would be to make a content analysis and complete, detailed design of the domain ontology which is finalized by formal representation and accumulation of domain ontology. In this paper, we took the domain ontology about Animal into consideration and built the ontology model with Protégé 4.0, which is a free, open source ontology editor and knowledge based framework, and reasoned the model with FaCT++. At the same time, on account of its ability of knowledge representation and better reasoning process support; OWL DL is taken as our domain ontology description language.

Basic Classes of Domain Ontology

As per our topic of research there are three basic classes which we have felt are more easy and adaptable in real time than any other class related to the domain ontology of anima which are Dog, Cat and Elephant.

Dog as a class in Domain ontology

The selection of dog as one of our domain ontology is that these creatures have shown tremendous behavioral changes before any form of natural disaster has devastated the earth bringing everyone literally to their knees. Dogs are considered man's best friend from the age of human and animal relationship existed. As dog's have evolved they too have well adapted to climatic transitions and become very sharp in various aspects. The normal behaviors of Dogs have been sleep, eat, swim, bark, run, bite, drink, wag the tail, play, etc. Before a natural disaster strikes the environment of its living, dogs exhibit plenty of behavioral changes such as not eating, restlessness, biting owners, panting, hiding in closures or in a secured place etc. these would be really helpful in situations of decision making.

Cat as a class in Domain ontology

According to a recent survey cats have beaten dogs on the pets to be kept indoors. Lots of kitties do some strange things, kitties run miles seeing water but at this point of time even like to swim. But if your kitty is doing something out of the ordinary for him, he could be sensing an earthquake. Because this is a fear-related behavior, many cats will either attempt to escape outdoors or hide under furniture for safety, kitty is just trying to protect himself from the possible effects of the frightening event that he senses. Other signs of anxiety over such an event include increased vocalization, pacing around, panting, loose

stools and an increase in destructive behaviors like scratching. You may even notice your fearful feline clinging to your side more than usual.

Elephant as a class in Domain ontology

Unlike Dogs and Cats elephants cannot be kept indoors and be played with for behavioral changes the 2004 tsunami which devastated most south East Asia saw elephants breaking the chains and fled to higher ground before the wave struck, saving their life.

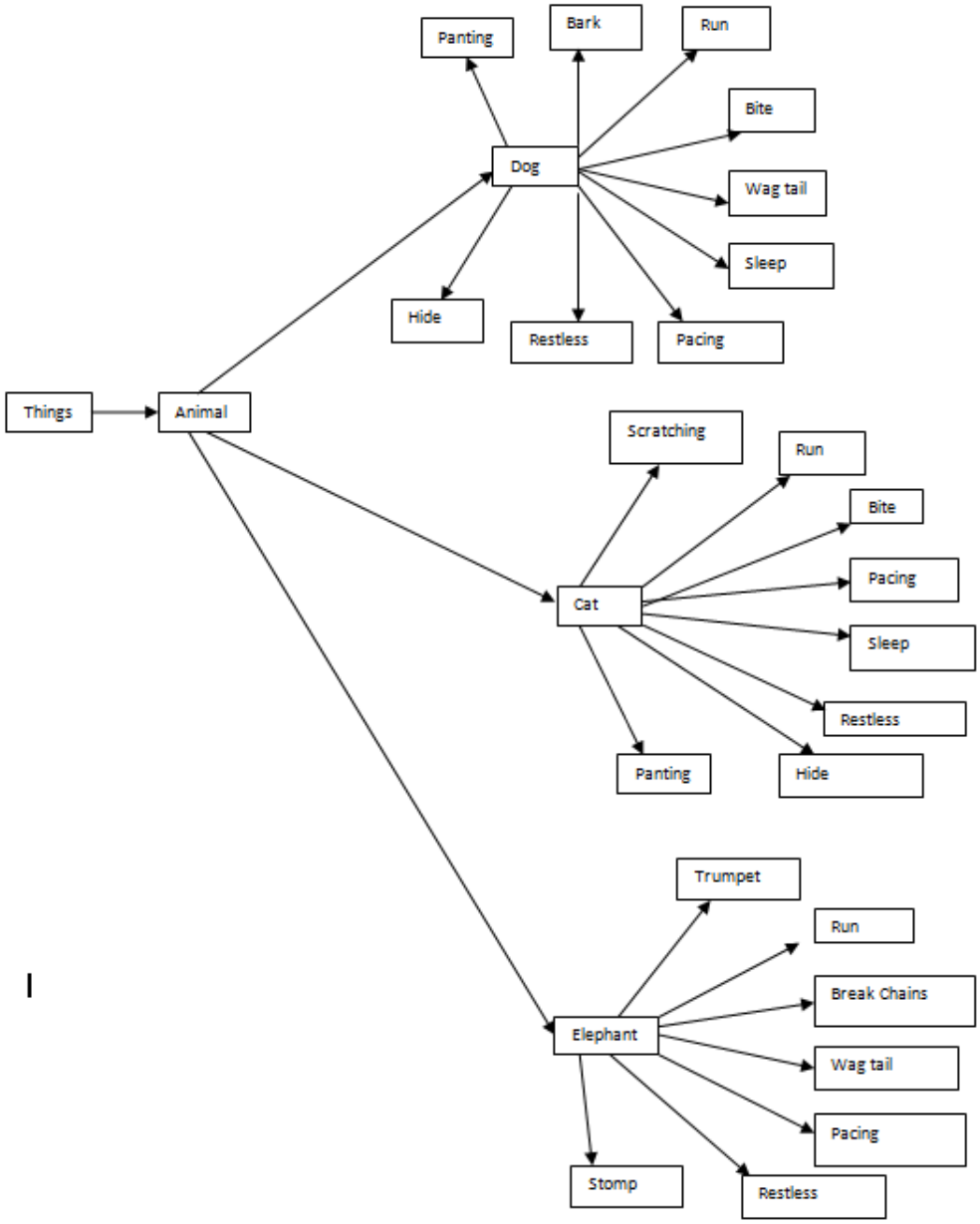

Fig. 5: Ontology model for main class

Relationship Between classes

Based on the existing related information and the abnormal activities show case by each of these animals at an event of natural disaster can be categorized into two major categories which are normal behavior and abnormal behavior. Hence beside the property subclass: Restless, panting pacing are some few relationships between the classes.

Case Study

For example let us take the dog class and do a little case study on how certain things will be done. In the case study we will use the point which will be our main domain or conceptualization which will be extensively watched over by humans or by cameras, later which will take a decision based on events occurred or recorded. We are aware that semantic network is a graph which is built up mainly on vertices and edges, where vertices indicate concepts and edges relationship between concepts. The decision is taken based on the behavioral

changes in various objects exhibited which do not match any behaviors defined by the class.

The class what we will be creating is named as Dog (a real-world class - a collection of similar objects, in this case, a collection of similar animals). Every class has associated data, or attributes. Attributes for Dog class are breed, color, height, weight, gender and name. Every class has associated actions or operations. Actions for Dog class are bark, sleep, bite, run and eat. Further on towards our system we require many sub classes which are associated with the class called as Dog. Sub classes can be inherited from the base class called as Dog as we cannot observe only one type of dogs for our case study as it won't be lead to any concrete decision to be taken towards our main objective towards an apprehensive decision making. For this system to make a decision making will be purely based on the behaviors exhibited by objects of that particular class.

For example the class diagram will have a base class called as Dog and various other sub classes such as Labrador, German Sheppard and Golden retriever will be inherited from the base class. As the inherited class have access to all public and protected members of the base class, the privileges are granted when the inheritance performed are public not private. If we would like to have any content of the base class hidden and to be accessed only the base class only as it can uphold the concept of data abstraction.

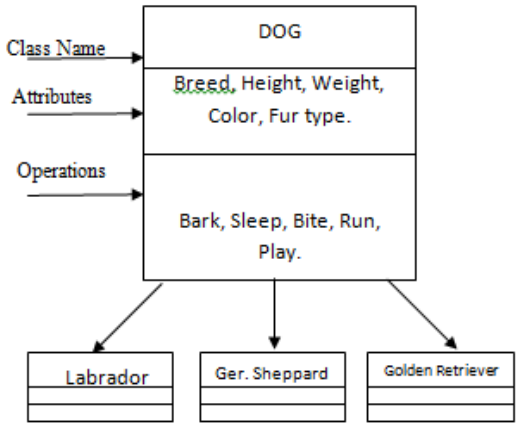

Fig. 6: A class Diagram depicting the system design.

After the class model is designed we would have a clear picture on how many classes are inherited and henceforth would be in a position to create any amount of objects of any class. For example if we create an object called evita of class Labrador and an object called rocky of German Sheppard and shadow an object of Golden retriever all the three objects of three different classes inherit the attributes and operations of base class Dog.

The attribute values for each object can vary depending on the objects created of relevant class. For example an object called evita might have Breed value as original, Height as 2, weight as 30, Fur type as medium. And each will have access to various operations which will define on various activities to be carried out by objects. Any amount of objects created would exhibit the same type of operations and would only vary on the attribute values but the operations would be considered same. After modeling the class diagram, the ontology now defines various objects, its attributes, relations, function terms, restrictions, rules and axioms.

In practical terms, developing ontology includes the following steps,

- First is to define classes in ontology.
- Secondly a taxonomic arrangements of classes (Subclass – Super class) hierarchy.
- Definition of slots and describing allowed values for these slots.
- Filling in the values for slots for instances.

Once finished we can create a knowledge base by defining individual instances of these classes by filling in specific slot value information and additional slot restrictions. The rules will be built in ontologies in such a way that any instance of a class whenever exhibiting a behavior will be recorded and matched along with the common behaviors already stored in a base or derived class. If the behaviors are existing then there won't be any significant changes but whereas if they record anything which does not exists already will be considered as a normal behavior.

Ontologies usually are expressed in terms of logic based knowledge representation language resulting in fine, accurate, consistent and meaningful distinctions can be made among classes, objects, properties, attributes and relations. Hence providing advance results in decision making and intelligent applications. When we want to express ontologies logically, it can be simple notation of taxonomy, to a thesaurus, to a conceptual model, to a logical theory.

CONCLUSION

This paper focuses on ontology based approach for disaster prediction recording and analyzing behavioral changes observed in 3 animals. Taking advantage of ontology modeling and reasoning mechanism, a domain ontology model for animal is developed. But these might not be the only classes to be read and needs to be assertive on taking such a decision hence on our future enhancement we would be adding birds and insects as another two classes to have a concrete prediction of any type of natural disaster. Such kind of practices of observing animals have not been only of the past as applications trying to develop using semantics and ontology on animal behavior can be observed and analyzed using various rules developed and can be really useful to saving plenty of lives.

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